



Indiana Department of
Environmental Management



Indiana Integrated Water
Monitoring and Assessment Report
to the U.S. EPA

2018

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EXECUTIVE SUMMARY

Section 305(b) of the federal Clean Water Act (CWA) requires states to prepare and submit a water quality assessment report of state water resources to the U.S. Environmental Protection Agency (U.S. EPA) every two years. States are also required to develop and submit a list of impaired waters to U.S. EPA for approval under CWA Section 303(d).

The Indiana Department of Environmental Management (IDEM) used data it collected and data collected by other organizations to develop this report. IDEM data used to develop this report were collected in accordance with IDEM's 2011-2019 Water Quality Monitoring Strategy (WQMS) and the revised 2017-2021 WQMS, which describe three primary monitoring approaches including: probabilistic monitoring, which employs a stratified random sampling design on a nine-year rotating basin, providing a comprehensive statewide data set for assessments every nine years; targeted monitoring designs that involve the intentional selection of sampling locations based on the specific monitoring objective to be met such as reassessments for Total Maximum Daily Load (TMDL) reports; and fixed station monitoring where the location of the year-round, monthly water chemistry samples does not change except in rare circumstances. These data are reviewed in accordance with the methods and procedures provided in IDEM's Consolidated Assessment and Listing Methodology (CALM) for the purposes of making CWA Section 305(b) water quality assessment and Section 303(d) listing decisions.

Indiana's water quality standards provide the basis for IDEM's CWA Section 305(b) water quality assessments, designating the uses for Indiana waters and the water quality criteria that Indiana waters must meet to ensure those uses are supported. Of the uses designated in the state's water quality standards, IDEM assesses aquatic life use support, recreational use support, and support of fishable uses. IDEM also assesses drinking water use support on surface waters that serve as a public water supply. Although there are additional uses designated in Indiana's water quality standards, IDEM limits its assessments to these four uses because the criteria in place to protect them are more stringent than those necessary to protect other uses. Thus, by protecting these four uses, other uses such as agricultural and industrial uses will be also supported.

IDEM completed its first comprehensive aquatic life use support assessments for the entire state in 2002 and reported similar information for recreational uses in 2012. The 2002 Indiana Integrated Water Monitoring and Assessment Report (IR) was the state's first baseline report on water quality and has been revised biennially since then. The 2018 IR provides the most recent comprehensive report on Indiana water quality to date. Results from IDEM's comprehensive use support assessments are provided in this report. Cumulative results for IDEM's stream-specific assessments are summarized in Table 1 (Appendix A). Approximately 69 percent of the 38,050 stream miles assessed for aquatic life use were found to be fully supporting. Approximately 24 percent of the 32,848 stream miles assessed support full body contact recreational use. Almost all of Indiana's 67 miles of Lake Michigan shoreline fully supports aquatic life use, while almost none of the shoreline waters support full body contact recreational use.

Causes of nonsupport (impairment) are reported for each waterbody type including rivers and lakes. Lake Michigan and its shoreline in Indiana are discussed in more detail in separate sections of this report. Pathogens continue to be the top cause of stream impairments, impacting more than 24,687 miles of streams. Polychlorinated biphenyls (PCBs) in fish tissue impacts 5,284 miles while mercury in fish tissue impacts 693 miles of streams. Almost 8,400 stream miles also have biological communities with measurable adverse response to stressors, many of which remain unknown.

Potential sources affecting Indiana waters include nonpoint sources that impact 16,099 miles of streams, while unknown sources impact at 10,322 miles. IDEM has several programs in place to address nonpoint source pollution. The Nonpoint Source (NPS) Program and the Total Maximum Daily Load (TMDL) Program work towards restoring waters of the State. The NPS Program's watershed specialists promote the holistic watershed approach by working closely with locally-led watershed groups.



INTRODUCTION

States are required by the federal Clean Water Act (CWA) to prepare a water quality assessment report of state water resources and a list of impaired waters to submit to the United States Environmental Protection Agency (U.S. EPA) every two years. In 2002, the U.S. EPA encouraged states to combine the information that was previously submitted as two separate reports (the CWA Section 305(b) water quality monitoring and assessment report and the Section 303(d) list of impaired waters), into one integrated report following the two-year schedule mandated in CWA Section 305(b).

The Indiana Department of Environmental Management's (IDEM's) Office of Water Quality (OWQ) publishes the Indiana Integrated Water Quality Monitoring and Assessment Report (IR) every two years. IDEM's OWQ prepared the 2018 IR following the guidelines provided by U.S. EPA (1997a, 1997b, 2005, 2006b, 2009b, 2011, 2013, 2015, and 2017). This report for 2018 meets all the reporting requirements in Sections 305(b), 303(d) and 314 of the CWA.

Using U.S. EPA's integrated format, Indiana's IR contains two lists – the Consolidated List and the 303(d) List of Impaired Waters. While they differ in purpose and scope, together they provide a comprehensive assessment of surface water quality conditions throughout the state of Indiana. The Consolidated List contains assessment information for all waters of the state, which is developed to fulfill

CWA Section 305(b) requirements. The 303(d) List of Impaired Waters is a subset of the Consolidated List and identifies only those waters that are impaired and for which total maximum daily loads (TMDLs) are required per CWA Section 303(d). In accordance with U.S. EPA guidance, the IR also contains information on trends and trophic state of Indiana's lakes pursuant to CWA Section 314 as well as information pertaining to Indiana's ground water and wetland resources.

Most of the data used in this report were collected by IDEM's Probabilistic Monitoring Program, which employs a stratified random sampling (probabilistic) design to generate a representative set of sampling locations for each nine major watershed management basins (Appendix B, Figure 1) as defined in IDEM's Surface Water Quality Monitoring Strategy (IDEM revised 2017-2021). IDEM uses probabilistic results to make comprehensive use support assessments, which are statistically valid statements about the overall water quality within each watershed. The same data used to make comprehensive statistical assessments for a given basin are also applied to the specific stream or stream reach from which they were collected in order to make site-specific assessments of the individual waterbodies within that basin.

In addition to data from the Probabilistic Monitoring Program, results from IDEM's targeted monitoring programs were used to make the water quality assessments included in this report, including the Fixed Station Monitoring Program, the Watershed Characterization Program, the Fish Tissue Contaminant Program, the Performance Measures Monitoring Program, the Cyanobacteria Monitoring Program, and the Special Studies Program. Results from monitoring conducted by Indiana-University's Indiana Clean Lakes Program, which operates under a contractual agreement with funding from IDEM, were also used.

In previous reporting cycles, IDEM stored assessment information – waterbody assessment unites and decisions regarding their water quality conditions based on the data collected – in the Assessment Database (ADB). For the 2018 cycle, IDEM is transitioning to U.S. EPA's new Assessment and Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS), which has been updated to provide states the ability to manage their assessment online and to streamline review and approval processes. To facilitate the transition to ATTAINS, IDEM has provided the data contained in its ADB to U.S. EPA for upload into the new system. When U.S. EPA has completed the upload and IDEM is able to verify the results, IDEM will begin entering its water quality assessments and other integrated reporting information directly into ATTAINS.

BACKGROUND

Indiana is located on the eastern edge of the North American great interior plains. The North-South continental divide traverses northern Indiana, dividing the state into two major drainage basins, the Great Lakes basin and the Mississippi River basin. Surface water in the northern one-quarter of the state flows north into the Great Lakes and then through the St. Lawrence River to the Atlantic Ocean. The southern three-quarters of the state drains into the Ohio River or Illinois River, then flows into the Mississippi River, which flows south to the Gulf of Mexico.

Indiana has approximately 62,547 miles of rivers, streams, ditches and drainage ways based on the Indiana Reach Index, which is a map of Indiana waters based on the U.S. Geological Survey's (USGS') high resolution (1:24,000 scale) National Hydrography Dataset (UGSG 2014). State water types are described in Table 2 (Appendix A). Metadata and definitions for this report are located in Appendix C.

WATER POLLUTION CONTROL IN INDIANA

Water pollution control authority is shared by several agencies in Indiana. IDEM holds authority to carry out several federal Clean Water Act (CWA) programs, including Sections 305(b), 303(d), 314, and others. The Indiana State Department of Health (ISDH) holds regulatory authority over septic systems, and the Office of the Indiana State Chemist (OISC) regulates pesticides and nutrients. The State Soil Conservation Board (SSCB), Indiana State Department of Agriculture (ISDA), Indiana Department of Natural Resources (IDNR) – including its Lake and River Enhancement (LARE) Program and its Lake Michigan Coastal Program (LMCP) – administer voluntary and grant programs to help abate various types of nonpoint source pollution. Indiana also partners with many federal agencies and nonprofit organizations in order to accomplish its work, including assistance from the:

- United States Geological Survey (USGS)
- United States Environmental Protection Agency (U.S. EPA)
- United States Department of Agriculture (USDA)
- United States Fish and Wildlife Service (USFWS)
- United States Forest Service (USFS)
- United States Army Corps of Engineers (USACE)
- National Park Service

Additional research, technical and funding assistance is provided by Purdue University and its Cooperative Extension Service, Indiana University, The Nature Conservancy, the Indiana Water Monitoring Council, county soil and water conservation districts, and many local non-profit and ad-hoc watershed groups.

IDEM'S WATERSHED APPROACH

The Indiana Department of Environmental Management (IDEM) employs a watershed approach in its Clean Water Act (CWA) programs. This approach is hydrologically defined and geographically focused, providing an effective framework to address water quality issues by taking into account land, air, and water stressors. Key benefits of the watershed approach are that it integrates multiple programs through coordination of public, private, and not-for-profit stakeholders and leverages limited resources to address priority concerns.

The foundation of IDEM's watershed approach is internal and external collaboration across program areas via timely and effective communication and through adaptive management. IDEM's work with other state and federal agencies and other external organizations is described in more detail in later sections of this report.

Internally, IDEM's senior staff members, including the commissioner, meets weekly to discuss progress on priorities as well as emerging concerns, and this information is relayed to IDEM Office of Water Quality (OWQ) managers at their weekly meetings. Cross-program teams continually work to develop strategies and work plans that ensure that internal resources are focused on addressing the most significant environmental issues affecting water quality.

IDEM's water quality monitoring also employs a watershed approach. IDEM adopted a statewide rotating basin approach to watershed monitoring in 1996 in order to regularly update the water quality information for the entire state. From 1996-2010, IDEM monitored watersheds throughout the state on a five-year rotation, which provided a complete update once every five years.

In 2010, IDEM revised its water monitoring strategy and began using a nine-year rotating basin approach. This approach was implemented in 2011 and will result in a comprehensive and updated data set for the entire state in 2019. The water quality assessments included in this report are cumulative and include all waterbodies that have been assessed to date in all basins of the state. Figure 1 (Appendix B) shows the monitoring locations for all of IDEM's surface water sampling programs and illustrates the sampling density achieved through IDEM's water quality monitoring strategy over the past five years (2013-2017).

IDEM's OWQ programs work together to protect and improve the quality of Indiana's surface waters. Indiana's water quality standards, which are developed by the OWQ Water Quality Standards (WQS) program, provide the foundation for implementation of many of IDEM's CWA programs. IDEM's water monitoring programs provide much of the data necessary to conduct CWA Section 305(b) water quality assessments and to support the development of Indiana's 303(d) List of Impaired Waters and total maximum daily loads (TMDLs) required under Section 303(d) of the CWA.

Nonpoint source (NPS) pollution is addressed primarily through non-regulatory watershed management planning and implementation projects funded through IDEM's NPS Program and supported by the development of TMDLs for impaired waters. The agency's National Pollutant Discharge Elimination System (NPDES) provides a robust regulatory program to control point sources of pollution to Indiana surface waters.

IDEM also works with the Indiana Finance Authority to issue low-cost loans to communities for infrastructure improvements to their wastewater and drinking water facilities. Many of these loans go to municipalities in watersheds where water quality impairments have been identified and for which TMDLs have been approved by the U.S. EPA. It is anticipated that in time these projects will result in measureable improvements in water quality.

IDEM'S OFFICE OF WATER QUALITY PROGRAMS AND ACTIVITIES

Water Quality Standards Program

The Indiana Department of Environmental Management (IDEM) is the state agency responsible for the ongoing development of Indiana's water quality standards (WQS), which can be found online in 327 Indiana Administrative Code (IAC) Article 2 at: www.in.gov/legislative/iac/iac_title?iact=327. Indiana's WQS were first adopted into the IAC in 1986 and underwent significant revisions in 1990. At that time, Indiana adopted numeric criteria into its WQS for all pollutants for which United States Environmental Protection Agency (U.S. EPA) had developed ambient water quality criteria for the protection of either human health or aquatic life. Procedures for developing additional criteria were also included in these rules.

Designated uses, which are the uses that the waterbody should support, were also established at that time. With few exceptions, all waters in Indiana were designated for warm water aquatic life use, full body contact recreational use, public water supply¹ (where there are drinking water intakes from surface

¹There are 34 streams or stream reaches designated for limited use in 327 IAC 2-1-11(a) and 327 IAC 2-1-1.5-19(a). These waters were placed in this category after use attainability analyses confirmed their inability to fully support aquatic life use due to natural low flow conditions throughout much of the year. In 2007, another limited use designation was added to Indiana's WQS in 327 IAC 2-1-3.1, which is applicable only to waters receiving wet weather discharges from combined sewer overflows. There are no waters currently designated for this use because to

waters), industrial uses and agricultural uses. In addition, certain waters, where natural temperature conditions will support cold water fisheries, were designated for put-and-take trout fishing. For those waters where multiple uses exist, the criteria that support the most stringent uses must be met. The most stringent criteria in Indiana's WQS are those established to protect aquatic life use, recreational uses for all Indiana waters and, where applicable, public water supply. IDEM's water quality assessments focus primarily on these uses and are based on the narrative and numeric criteria in the WQS established to protect them.

National Pollutant Discharge Elimination System (NPDES) permits are also based on Indiana's WQS. In 1993, the rules and regulations that guide the implementation of Indiana's WQS through NPDES permits were extensively revised. Although this revision resulted in significant changes to these rules, only minor changes were made to Indiana's WQS.

With the issuance of the final Great Lakes Water Quality Guidance in 1995, IDEM began the process of revising the WQS and implementation regulations for those waters in Indiana's Great Lakes system. These revisions incorporated the various criteria and procedures identified in the guidance into Indiana's WQS. As a part of this rulemaking, IDEM also developed procedures to implement the antidegradation policy for all substances discharged to waters in the Great Lakes system. These revisions adopted by the Indiana Water Pollution Control Board became effective in February 1997 and were subsequently submitted to U.S. EPA for approval.

Drinking water from public water supplies is regulated through the Safe Drinking Water Act (SDWA). IDEM defines public water supplies in accordance with the SDWA and has established minimum requirements regarding the information included in consumer confidence reports, which public water suppliers deliver to their customers annually. Indiana's surface WQS are in place to protect public water supplies withdrawn from rivers and streams. However, many public water supplies rely on water drawn from ground water sources. In 2002, Indiana passed ground WQS to help maintain and protect the quality of Indiana's ground water resources and ensure that exposure to ground water will not pose a threat to human health.

In 2012, Indiana formally adopted antidegradation standards and implementation procedures applicable to all waters of the state. These rules supersede previous antidegradation rules established in 1997 which applied only to the Great Lakes Basin. And in 2013, Indiana adopted revised chloride criteria developed by the WQS Program based on hardness and sulfate concentrations.

Indiana's WQS include both numeric and narrative water quality criteria, which together provide the foundation for the protection of Indiana's water resources. WQS development is an ongoing process, both in terms of numeric water quality criteria and the development of methods to allow for implementation of Indiana's narrative criteria.

date, no communities with combined sewer overflows have completed the use attainability analyses and other steps required to receive this designation. Indiana's WQS also include waters that are designated as outstanding state resources in 327 IAC 2-1.5-19(b), 327 IAC 2-1.3-3(d) and 327 IAC 2-1-11(b). Thus, all waters in the state are currently designated for uses consistent with the requirements of the Clean Water Act or U.S. EPA's implementing regulations and have criteria appropriate to determine support of these uses.

For example, in the absence of a numeric criterion for polychlorinated biphenyls (PCBs) in fish tissue, IDEM calculated a numeric value for the maximum allowable concentration of PCBs in fish tissue based on U.S. EPA guidance for developing water quality criteria for the protection of human health. This value allowed IDEM to begin using fish tissue data for the first time in 2008 to make assessments of how well Indiana waters support fish consumption.

Current Water Quality Standards Development

IDEM is also currently planning revisions to the numeric metals criteria in the WQS for the protection of aquatic life and human health. On March 5, 2014, IDEM issued a first notice in the Indiana Register announcing a rulemaking to formally incorporate revised water quality criteria for dissolved metals into Indiana's water quality standards. More information about this rulemaking can be found on IDEM's WQS website at: www.in.gov/idem/cleanwater/2329.htm.

IDEM has been actively working to develop numeric nutrient criteria as required by the U.S. EPA to support Clean Water Act (CWA) assessments and permit development. U.S. EPA has issued guidance that allows states some flexibility in the development of nutrient criteria if the state and U.S. EPA have agreed on a plan to accomplish this goal. Indiana submitted its nutrient criteria development plan, which includes a schedule for criteria development, to U.S. EPA in 2009. U.S. EPA approved the plan in 2009. IDEM provides updates annually regarding its progress towards meeting nutrient criteria development goals.

In accordance with the approved plan, IDEM is working with U.S. EPA and the U.S. Geological Survey (USGS) to develop nutrient criteria for different types of waterbodies types throughout the state. IDEM has worked collaboratively with the USGS in Indianapolis over the last 14 years to collect and analyze relevant stream data from waters throughout the state. For lakes and reservoirs, data analysis was completed in 2008 through a contract with LimnoTech, Inc. IDEM then performed additional analyses on the data set to refine the nutrient benchmarks developed by LimnoTech.

On June 30, 2010, IDEM issued a first notice in the Indiana Register announcing a rulemaking to formally incorporate numeric water quality criteria for total phosphorus for lakes and reservoirs into Indiana's WQS. Following the first notice, IDEM convened an internal work group for further development of the rule. Based on stakeholder concerns regarding impacts of implementing the criteria, the work group determined it was premature to proceed with the second notice.

IDEM continues working toward the development of numeric nutrient criteria for rivers and streams. In the meantime, to reduce the amount of nutrients entering Indiana waters, IDEM developed a non-rule policy that went into effect on December 12, 2014 limiting total phosphorus discharge to one milligram per liter (mg/L) for wastewater treatment plants discharging less than or equal to one million gallons per day.

In 2017, using federal CWA Section 106 Monitoring Initiative Funds from U.S. EPA, IDEM's OWQ began a pilot study, which when the project is complete in 2019, is expected to provide a better understanding of the complex relationships between nutrients, primary productivity, dissolved oxygen fluxes over a 24-hour period, and biological community response indicators in these highly dynamic systems. IDEM is also working to develop algal metrics, which combined with those for fish communities and macroinvertebrates, will provide three different types of stream biota to correlate with water chemistry data to help determine critical levels of nutrients.

In 2017, U.S. EPA Headquarters selected IDEM to work with on a case study using a new statistical model (developed by U.S. EPA) that considers National Lakes Assessment Program data and monitoring results from Indiana's Clean Lakes Program and sampling conducted by IDEM to derive an Indiana-specific criterion for total nitrogen to protect for Microcystin impacts to designated uses. IDEM anticipates the development of this model in fall, 2018.

IDEM also participates in the Indiana Conservation Partnership (ICP) and worked closely with the Indiana State Department of Agriculture (ISDA) on the development of Indiana's State Nutrient Reduction Strategy, which is discussed in more detail later in this report.

National Pollutant Discharge Elimination System Permit Program

Point source pollution in Indiana is controlled primarily through permits issued by IDEM for discharges to surface water under the NPDES Permit Program in IDEM's Permits Branch. Regulated facilities which discharge to waters of the state must apply for and receive a NPDES permit. Limitations in each permit are determined based on water quality criteria developed to protect all designated and existing uses of the receiving water body.

The Permits Branch issues individual (municipal, semi-public and industrial) NPDES permits. The program also issues industrial wastewater pretreatment permits to industries that discharge to municipal wastewater treatment plants. In addition, the Permits Branch issues general permits for:

- Hydrostatic testing of commercial pipelines.
- Non-contact cooling.
- Sand and gravel operations.
- Petroleum product terminals.
- Groundwater petroleum remediation systems.
- Allen County On-site Discharging Systems.
- Coal mines.

IDEM is currently in the process of changing its approach to general permits from permit-by-rule to administrative general permits. The first five permits listed above were converted/issued in November 2015. The general permits for Allen County On-site Discharging Systems and for coal mines are still in progress with target issuance dates of 2019 and 2020, respectively.

There are currently 1,182 active individual NPDES permits, 187 pretreatment permits, and 268 facilities covered by general permits. The Permits Branch is also responsible for the review and approval of long term control plans (LTCPs) submitted by communities to reduce discharges from combined sewers. All of Indiana's combined sewer overflow communities are under an enforceable mechanism. These mechanisms are in place to ensure implementation of approved LTCPs and/or to develop and implement an approvable LTCP.

Compliance and Technical Assistance Program

The Compliance Branch works closely with the Permits Branch and staff members from IDEM's Office of Water Quality (OWQ) Enforcement Section to ensure that permit limits are adequate for protection of designated uses and dischargers remain in compliance with their permit requirements. For example, when unpermitted discharges are identified, or when NPDES permit holders are found to be in violation of permit limitations or conditions, Compliance Program staff members may refer them to the Enforcement Section for appropriate action. Other Compliance Branch responsibilities include:

- Conducting routine inspections of wastewater treatment plants to evaluate NPDES compliance, as well as complaint investigations.
- Evaluation of compliance data, including data quality assurance.
- Conducting informal enforcement actions through the issuance of noncompliance letters, and assisting in the enforcement process.
- Oversight and auditing of municipal pretreatment programs in the 47 municipalities with U.S. EPA-delegated pretreatment programs.
- Providing laboratory assistance, operator technical assistance and training.
- Administration of the Wastewater Certification and Continuing Education Program.
- Recording a wide range of NPDES permit and compliance data into the Federal Integrated Compliance Information System (ICIS).
- Working in concert with other OWQ staff members in automating data flows to ICIS.
- Receiving, recording and tracking reported bypass and overflow events.
- Administration of the sewer ban and early warning program.
- Administering the laboratory proficiency program.
- Making public records available in IDEM's Virtual File Cabinet.

Storm Water Program

Storm water run-off from urban, industrial, and rural areas contributes to water pollution in Indiana. IDEM's storm water programs process permit applications and issue permits, conduct compliance inspections, and conduct audits for the three program areas that together help mitigate the impacts of storm water to Indiana waters. These program areas target storm water discharges from construction site run-off, industrial storm water run-off, and municipal separate storm sewer systems. The Storm Water Program and the Wetlands Program reside within the same section in OWQ's Permits Branch which has allowed valuable opportunities for cross-training and coordination. As a result, storm water staff members are now able to conduct compliance inspections related to suspected wetlands violations and to recognize and document violations while inspecting a site.

Most of the activities that discharge storm water are regulated through general permits. The general permit requirements are contained in IAC and set by Indiana's Environmental Rules Board through its formal rulemaking process. Unlike individual permits that IDEM issues to individual permittees when needed, general permits apply universally to all entities required to operate in accordance with the rule.

Construction Site Run-off

Any activity that results in the disturbance of one acre or more of land requires a permit in accordance with 327 IAC 15-5 (commonly known as “Rule 5”). Rule 5 is intended to reduce pollutant run-off and sedimentation which can occur as a result of soil erosion. Rule 5 also covers other activities associated with the construction projects including, concrete washout and fueling. Most construction projects in Indiana are regulated through the general Rule 5 permit.

Industrial Storm Water

Industrial storm water is managed through a general permit developed in accordance with 327 IAC 15-6 (commonly known as “Rule 6”). Rule 6 permits are required for certain categories of industrial activities that are exposed to storm water and where the run-off is discharged through a point source.

There are at least 32 categories of industrial activities regulated under Rule 6, which can be found online at: www.in.gov/ideM/stormwater/2384.htm. Most industrial activities in Indiana are covered by the Rule 6 general permit. However, under certain circumstances, an industrial facility may require an individual storm water permit. Individual permits are typically required only if a regulated industrial activity category has established effluent limitations under IDEM’s NPDES Program or if IDEM determines the storm water discharge will significantly lower water quality. Industrial facilities may also request or be required to obtain an individual permit that covers both storm water and wastewater. These permits are issued by the Wastewater Permits Section.

Municipal Separate Storm Sewer Systems

Municipal separate storm sewer systems (MS4s) are entities that are required by IDEM under 327 IAC 15-13, or “Rule 13” to develop and implement a local storm water management program. The first MS4s were designated in 1990 and included cities (and certain counties) with a population of 100,000 or more. In Indiana, the City of Indianapolis is currently the only designated Phase I MS4. The city has an individual storm water permit that was specifically written to address storm water quality and management.

Federal Phase II MS4 rules were complete in 1999 and designated small urbanized areas such as cities, towns, universities, colleges, correctional facilities, hospitals, conservancy districts, homeowner's associations and military bases located within urbanized areas, as delineated by the U.S. Census Bureau. Indiana currently has 186 MS4 permittees implementing Storm Water Quality Management Plans under a general permit. The fourth permit cycle will begin in the late fall of 2018. Under the general permit, these MS4s are required to develop a storm water quality management plan that addresses six minimum control measures:

- Public education.
- Public involvement.
- Illicit discharged detection and elimination.
- Construction site run-off.
- Post-construction run-off.
- “Good housekeeping” for MS4 owned and operated facilities.

In addition to their regulatory role, storm water staff members provide education and training to the regulated community including local MS4s. Training not only includes education on the rules and

regulations, but also technical training related to planning principles, storm water plan development and review, storm water quality/quantity measure design and implementation, and monitoring. The program also maintains a technical manual that specifically targets project site planning, construction site storm water measures, and post-construction measures. The Indiana Storm Water Quality Manual is available online at: www.in.gov/ideM/stormwater/2363.htm.

Wetlands Program

IDEM regulates the placement of fill materials, excavation (in certain cases) and mechanical clearing of wetlands and other waterbodies through its CWA Section 401 Water Quality Certification (WQC) Program and Indiana's State Isolated Wetlands law (Indiana Code (IC)13-18-22), which covers wetlands that are not under federal jurisdiction. IDEM's regulatory authority comes from the federal CWA, a combination of state law and administrative rules for state-regulated wetlands, and from Indiana's water quality standards. IDEM regulates some activities in waterbodies in conjunction with the U.S. Army Corps of Engineers (USACE).

Anyone who desires to place fill materials, use heavy equipment to excavate or dredge, or mechanically clear areas within a jurisdictional wetland, lake, river or stream must obtain a CWA Section 404 permit from the USACE. If the USACE determines a permit is needed, then the person must also obtain a CWA Section 401 WQC from IDEM. Placement of fill into non-jurisdictional wetlands, as determined by the USACE are regulated by Indiana law (IC 13-18-22 and 327 IAC 17).

Currently, if the USACE has determined a Section 404 permit is required for a project, under CWA Section 401, IDEM reviews the proposed activity to determine if it will comply with Indiana's WQS. The applicant may be required to avoid impacts, minimize impacts, or mitigate for impacts to wetlands and other waters. IDEM will deny the WQC if the activity will cause adverse impacts to water quality, the application is deficient, the wetland activities are not necessary, or compensatory mitigation does not offset impacts. A regulated project may not proceed until it has received a certification from IDEM. A key goal of the program is to ensure that all activities regulated by IDEM meet the national no-net-loss of wetlands policy.

Assumption of the Clean Water Act Section 404 Permit Program

In 2017, IDEM began investigating the resources and authorities it would need to transfer authority for the federal CWA Section 404 program from the USACE to IDEM under the rules provided for state assumption of the program in CWA Section 404(g). In the 40 years since the CWA was enacted, only two states (Michigan and New Jersey) have been allowed to assume the regulatory authority and responsibilities of the Section 404 program. Over the next 1-2 years, IDEM will be collaborating with its state and federal partners –the Indiana Department of Natural Resources (IDNR), the U.S. Fish and Wildlife Service (USFWS), U.S. EPA, and the USACE– as well as various stakeholders to determine whether the benefits of assumption to the state outweigh the costs it will incur.

In-lieu Fee Program

On May 3, 2018, the IDNR received final approval from the USACE and the Interagency Review Team to sponsor the Indiana Stream and Wetland Mitigation Program, also referred to as the “in-lieu fee program”. The program meets the requirements laid out in the federal mitigation rule (33 Code of Federal Regulations (CFR) Section 332.8). The in-lieu fee program provides an additional option for permittees to meet mitigation requirements associated with a Section 404 permit from the USACE, a 401 Water Quality Certification and/or an Isolated Wetland Permit from IDEM.

IDEM’s Wetland Protection Activities

Wetlands occur in and provide benefits to every county in Indiana. The lack of quantitative information on some aspects of Indiana’s wetland resources is a major obstacle to improving wetland conservation efforts. The most extensive database of wetland resources in Indiana is the National Wetlands Inventory (NWI) developed by the USFWS. The original NWI maps were produced primarily from interpretation of high-altitude color infrared aerial photographs taken of Indiana during spring and fall 1980-1987. These maps were updated at a much higher resolution during 2008-2009 through a grant to Ducks Unlimited. The updated maps indicate wetlands extent and type, based on the Cowardin, *et al.* classification scheme (Cowardin 1979). The project also included an analysis of the state’s wetlands compared with 1986 conditions, which indicated that Indiana has experienced a net loss in:

- The number of emergent, forested, shore, and scrub-shrub wetlands.
- Extent (acres) of forested, scrub-shrub, and shore wetland sub-types.

Currently, IDEM’s Wetlands Program uses the updated, higher resolution NWI inventory primarily as a screening tool when evaluating applications for impacts to wetlands and streams and also to help identify wetland compensatory mitigation or restoration sites. It has also helped IDEM wetland staff members to set priorities for complaint investigations.

In addition to reviewing applications and issuing Section 401 WQCs and state-regulated wetland permits, IDEM’s Wetlands Program conducts inspections to ensure compliance with the certification or permit, including any mitigation required for the project. Section 401 WQC Program staff members also conduct outreach events at various locations to promote the importance of wetlands and to educate the public on regulations related to protecting wetlands. The program also works on additional projects devoted to wetland assessment and wetland protection:

- IDEM staff members work closely with the USACE, USFWS, and IDNR to evaluate proposed projects for various state and federal permits related to wetlands and streams.
- IDEM maintains a web page devoted to wetlands and water quality issues at www.in.gov/idem/wetlands/index.htm. This page includes information on the status of Indiana’s wetlands, current laws and rules, conservation programs and links to other regulatory and non-regulatory wetland programs.
- IDEM maintains a web-based mapping tool for potential wetland restoration sites, including opportunities for compensatory mitigation and non-regulatory purposes at www.in.gov/idem/wetlands/pages/mitigation/.

Wetlands Program Plan

Indiana published its wetlands program plan in 2015. U.S. EPA provided funding for IDEM to develop the Indiana Wetlands Program Plan (IWPP) to describe the goals and objectives Indiana wants to achieve related to its wetland resources. Development of the IWPP was voluntary and does not assume any new regulation on the part of U.S. EPA, nor does it represent any rulemaking or new regulation on the part of IDEM. Rather it serves to inform priorities and future development of IDEM's Wetlands Program.

IDEM was the lead agency in the development of the IWPP and worked with multiple state and federal partners including, ISDA and IDNR, USACE, USFWS, USGS, and U.S. EPA, and the National Resources Conservation Service (NRCS) to gather their input and that of hundreds of stakeholders. The full plan is available online at: www.in.gov/idem/wetlands/files/program_plan.pdf.

Total Maximum Daily Load Program

IDEM's Total Maximum Daily Load (TMDL) Program works with IDEM's Nonpoint Source (NPS) Program and stakeholders in watersheds with impaired waters to conduct TMDL evaluations and develop TMDL reports. A TMDL evaluation is a process that quantifies the amount of a specific pollutant that a waterbody can assimilate and still meet WQS. What constitutes a pollutant is described in Section 502(6) of the CWA and includes materials such as sewage, chemical wastes, biological materials, and wastes from industrial, municipal, and agricultural operations. The definition also encompasses drinking water contaminants that are regulated under Section 1412 of the Safe Drinking Water Act (SDWA). A TMDL report is a written, quantitative assessment that accomplishes the following:

- Identifies how much of the pollutant is coming from point sources and nonpoint sources.
- Specifies the amount of pollutant reduction necessary from each source in order to meet the WQS set for that pollutant.
- Lays the groundwork for developing and implementing a plan to reduce the amount of the pollutant coming from each source.

As of April 1, 2018, the Total Maximum Daily Load (TMDL) program has developed 2,076 TMDLs for waterbodies with one or more water quality impairments, all of which have been approved by U.S. EPA. Appendix D provides an accounting of all TMDLs approved to date. TMDLs completed prior to 2014 focused primarily on *E. coli* impairments. More recently however, IDEM has been developing TMDLs for other issues related to NPS pollution such as impaired biotic communities and nutrient impairments.

In 2013, the U.S. EPA announced its long term vision to improve implementation of the CWA 303(d) Program through a new framework for managing program responsibilities. In order to achieve the goals of its vision, U.S. EPA required states to develop a new framework for prioritizing impaired waters for TMDL development.

In 2015, IDEM developed its TMDL Program Priority Framework, which describes IDEM's methods for prioritizing waters for TMDL planning and watershed restoration. IDEM's TMDL Program Priority Framework and its Priority Ranking, which identifies the watersheds in which IDEM's TMDL development efforts will be focused now through 2022 is provided in Appendix E. IDEM submitted both to the U.S. EPA on July 8, 2015, which were reviewed and approved on September 16, 2015. IDEM revised the Priority Ranking in Appendix E to reflect its short-term TMDL development schedule, which identifies the watersheds in which TMDLs are planned for the 2020 integrated reporting cycle.

The specific waterbodies identified on IDEM's original Priority Ranking may change based on unanticipated circumstances. Although the specific waterbodies may change, IDEM will continue to follow the methods described in its Program Priority Framework when prioritizing impaired waters for TMDL development to ensure ongoing consistency with U.S. EPA's long term vision.

Nonpoint Source Pollution Program

NPS pollution in Indiana is addressed in many ways through a number of agencies and organizations in the state. IDEM's Watershed Planning and Restoration (WPR) Section leads the agency's efforts to reduce nonpoint source pollution in Indiana waters in partnership with other agencies and organizations including the Indiana Association of Soil and Water Conservation Districts (IASWCD), ISDA, IDNR, NRCS, and the Indiana Finance Authority State Revolving Fund (SRF) Loan Program. The WPR Section also leads efforts to restore waters of the state that are identified on the 303(d) List of Impaired Waters through its NPS Program, which provides grant funding and other types of assistance to support locally-led watershed planning and restoration efforts.

Much of this work is funded through IDEM's NPS Program, which administers two federal pass-through grant programs aimed at improving water quality in the state, Section 205(j) grants and Section 319(h) grants, both named after the authorizing section of the CWA.

Section 205(j) Grants

The Section 205(j) Grant Program is dedicated to water quality management planning. Funds are used to determine the nature, extent, and causes of point and nonpoint source pollution problems and to develop plans to solve these problems. In federal fiscal year (FFY) 2016-2017, U.S. EPA allocated \$648,000 in 205(j) funds to Indiana. These funds were used to support watershed management plan development in the following five watersheds, which will provide a strong foundation for future watershed restoration efforts:

- Big Blue River.
- Lower Patoka River.
- Big Walnut Creek.
- Upper Wabash River.
- Salt-Pipe Creek.

Section 319(h) Grants

The Section 319(h) Program is one of the primary resources for reducing NPS pollution in Indiana. The majority of these funds are used to support the development and implementation of watershed management plans (WMPs). Developing and implementing a comprehensive watershed management plan is an effective way to focus efforts and resources on a watershed and its particular problems and to

implement solutions to those problems. In the planning process the watershed group identifies the problems, causes, sources, and critical or target areas in the watershed, then sets goals and chooses measures or best management practices (BMPs) to be implemented to achieve those goals. WMPs now under development must meet the required elements of IDEM's 2009 Watershed Management Plan Checklist before they can be implemented with CWA Section 319(h) funds. The checklist incorporates EPA's nine required components of a watershed-based plan and also provides comprehensive guidance on IDEM's Nonpoint Source Program expectations, as well as examples and direction on how to meet those expectations. More information about IDEM's 2009 Watershed Management Plan Checklist and a description of the U.S. EPA's nine required elements can be found online at: www.in.gov/idem/nps/3429.htm.

Indiana's 319(h) Grant Program receives a significantly larger allocation than that under Section 205(j) of the CWA (Table 3, Appendix A). In FFYs 2016 and 2017, U.S. EPA allocated \$7,845,000 in Section 319(h) funds to Indiana, which funded a total of 23 projects. An additional \$63,000 project was funded in FFY 2015 using remaining funds from FFY 2015. Many of these projects are described online here: www.in.gov/idem/nps/2947.htm.

Several grant proposals are submitted for 319(h) funding each year by eligible organizations. Proposals are reviewed internally by a committee comprised of OWQ staff members and selected for funding based on the NPS Program's priorities and the quality of the proposal. Much of this funding goes to groups working to develop and/or implement a comprehensive watershed management plan which will lead to implementation of on-the-ground BMPs in critical areas of the watershed. In FFY 2016, IDEM also received an additional \$724,994 in 319(h) grant funds for the St. Marys Western Lake Erie Basin special monitoring project. These funds were above and beyond the nearly \$8 million awarded to Indiana in its FFY 2016 Section 319(h) grant allocation.

Many of the projects funded with NPS Program grants include the collection of water quality data for watershed planning and other purposes. In accordance with their grant agreements, these projects must develop a quality assurance project plan (QAPP) to ensure the data they collect will be reliable for their project needs. Once the QAPP is approved by the NPS Program, they may begin sampling and submitting their data – also a requirement for funding – to the NPS Program. These data are then entered into IDEM's Assessment Information Management System (AIMS) database. The AIMS database is continually maintained and has been upgraded to make NPS Program data more readily available for internal and external use.

Additional information about IDEM's 205(j) and 319(h) grant programs and their different requirements is available online at: www.in.gov/idem/nps/.

Watershed Specialists

In addition to providing grant funding, the NPS Program also employs five watershed specialists who provide an important link between watershed groups and other interested stakeholders and OWQ programs. In 2016 and 2017, the watershed specialists assisted nearly 138 watershed groups with many tasks including: meeting facilitation, reviewing draft and final watershed management plans, reviewing grant proposals, providing water quality data and watershed maps, connecting them with other local organizations and agencies to complement planning efforts, and assisting watershed coordinators with the overall watershed planning and implementation processes. The watershed specialists also work with the TMDL Program by attending TMDL public meetings to provide information on watershed planning and to build local partnerships to address water quality.

Nonpoint Source Program Priorities

IDEM's NPS Program is built on the foundation of the Indiana State NPS Management Plan. The State NPS management plan, required by Section 319(b) of the CWA, is a strategic document developed by IDEM and approved by U. S. EPA that identifies strategic priorities, goals, and milestones to more effectively address NPS problems in Indiana. The plan also provides the basis for funding decisions and programmatic direction for the state program and its partners. The current plan, which was developed in 2013, is available online at: www.in.gov/idem/nps/3036.htm. The U.S. EPA requires states to update their NPS management plans every five years. IDEM's NPS Program is currently revisiting the plan to provide an update to the U.S. EPA in 2018.

Each year, IDEM identifies priority projects for Section 319(h) funds consistent with the goals in the State NPS Management Plan in order to more efficiently meet NPS Program goals, coordinate with TMDL Program efforts to identify and reduce NPS pollution, and focus more funding on impaired waters. For FFYs 2017 through 2019, the NPS Program has focused funding on the following four priorities:

1. Develop a WMP or implement an IDEM approved WMP that will reduce nutrient loads within the following 8-digit Hydrologic Unit Code (HUC) watersheds identified as priorities in Indiana's State Nutrient Reduction Strategy. This strategy, which is available online at www.in.gov/isda/2991.htm, was developed through a collaboration between IDEM and ISDA to help meet the State NPS Management Plan goal to utilize partnerships to better leverage available resources for more effective nonpoint source pollution management. The following watersheds have been identified in the strategy as priorities for planning and implementation of BMPs to reduce nutrient loadings to lakes and streams:
 - Upper Wabash (05120101).
 - Middle Wabash-Deer (05120105).
 - Middle Wabash-Little Vermillion (05120108).
 - Middle Wabash Busseron (05120111).
 - Lower Wabash (05120113).
 - Upper White (05120201).
 - Lower White (05120202).
 - Maumee River (04100003, 04100005, 04100007, 04100004).
2. Develop a WMP or implement an IDEM approved WMP that includes a 10-digit HUC watershed with a surface water drinking water intake and waters identified in Category 5A of the Draft 2014 303(d) List of Impaired Waterbodies. This priority is intended to help meet the State NPS Management Plan goal to protect sensitive, vulnerable, and high quality waters of the state so that they may continue to meet their designated uses. This priority is reflected in the *FFY 2019 Solicitation Priority Watersheds* map, which is available on the NPS Program web page at: www.in.gov/idem/nps/3363.htm.
3. Develop a WMP or implement an IDEM approved WMP that includes a 10-digit HUC watershed that impacts outstanding state resource waters and/or waters with endangered, threatened, or rare species. This priority is also intended to meet the goal of protecting sensitive, vulnerable, and high quality waters of the state so that they may continue to meet their designated uses. As with the See the *FFY 2019 Solicitation Priority Watersheds* map.
4. Implement a WMP that meets the IDEM 2009 Watershed Management Plan Checklist. As noted earlier in this report, while IDEM now requires all WMPs now under development to meet the required elements of IDEM's 2009 Watershed Management Plan Checklist in order to receive

additional 319(h) funding for implementation, most plans developed prior to 2009 do not meet these requirements. However, funding may still be awarded to groups with older plans on a case-by-case basis depending on the level of the detail in the original plan. To assist groups with older plans to become more competitive for implementation grants, the NPS Program offers [guidance online](#) to help them determine if they need to either revise or totally rewrite their plans: www.in.gov/idem/nps/3454.htm, and the program's watershed specialists also provide assistance.

The NPS Program regularly assesses the success of its program in different ways. One important measure of the program's success is the quantity of pollutants, such as sediment, phosphorus, nitrogen, and *E. coli* that NPS-funded projects are preventing from entering Indiana waters as a result of BMPs implemented. Most NPS program projects in Indiana use the U.S. EPA Load Estimation Model to estimate the pollutant load reductions for each BMP they implement and provide their results to IDEM as part of their grant agreement. The total reported estimated pollutant load reductions in Indiana for FFY 2016 and 2017 are shown in Table 4 (Appendix A).

Another program measure (commonly referred to as "WQ-10" or "success stories") tracks the number of waterbodies identified by states as being primarily NPS-impaired that have been partially or fully restored as a result of restoration efforts (Table 5, Appendix A). More detail on Indiana's FFY 2016 and 2017 Success Stories can be found later in this report.

Volunteer Monitoring Programs

Hoosier Riverwatch

From 1999-2002, IDEM and IDNR worked cooperatively to develop and implement the Hoosier Riverwatch Program (HRW), a statewide volunteer stream water quality monitoring program. The mission of Hoosier Riverwatch is to involve the citizens of Indiana in becoming active stewards of Indiana's water resources through watershed education, water monitoring, and clean-up activities. The program accomplishes the first two parts of this goal by educating citizen volunteers in a variety of watershed and pollution issues and providing them with training and equipment to conduct water quality monitoring.

The HRW Program also maintains an online database which allows volunteers to enter their own data and view data collected by other volunteers. Volunteers are encouraged to enter their results into the database to make them available to other interested parties such as watershed groups, schools and IDEM technical staff members for potential use in various OWQ programs. In addition to basic search functions, the visualization tools of the database allow volunteers to view their data and that collected by others in comparison with state and watershed averages through simple graphics.

HRW resided at IDNR until late 2012 when the program moved to IDEM's OWQ to better integrate volunteer water monitoring with OWQ's watershed monitoring and planning activities. Since then, HRW has become more fully integrated into the Watershed Assessment and Planning Branch within OWQ. This integration has allowed better coordination with the NPS Program whose grantees commonly use HRW methods to meet the monitoring and outreach components of their funded projects and encourages greater data sharing through OWQ's External Data Framework (EDF). The HRW and NPS Programs are also exploring different ways that volunteer monitoring can become more fully involved in watershed planning and restoration efforts as a whole.

The move to IDEM also provides volunteer monitors more opportunities to interact with their professional counterparts. Since 2012, HRW program staff members have worked with OWQ biologists and others to offer training to the program's corps of trained volunteer instructors in topics such as:

- Basic fish and advanced macroinvertebrate identification.
- Introductions to IDEM's mobile *E. coli* van.
- The collection and analysis of fish tissue for consumption advisories, the use of various electrofishing gear.
- The process of estimating pollutant loads using flow and concentration data.

More information about Indiana's Hoosier Riverwatch program at IDEM can be found online at: <http://www.in.gov/idem/riverwatch/index.htm>

Clean Lakes Volunteer Monitoring Programs

The Indiana University School of Public and Environmental Affairs (IU-SPEA) has been working with IDEM's NPS Program since 1989 to administer the Indiana Clean Lakes Program (CLP). The Indiana CLP is funded through CWA Section 319(h) and provides a comprehensive, statewide public lake management program that includes public information and education, technical assistance, volunteer lake monitoring, and lake water quality assessment.

Indiana has more than 1,500 lakes, reservoirs, and ponds – many of which are under pressure from human activities such as poorly managed agriculture, suburbanization of lakeshores, boating impacts, and septic system discharges. These activities can result in excessive nutrient concentrations reaching lakes which can lead to accelerated eutrophication and related undesirable effects including nuisance algae, excessive plant growth, murky water, odor, and fish kills. Indiana's CLP, coordinated by IU-SPEA staff members and students, includes the following components:

- Annual professional sampling of lakes and reservoirs.
- Training and support of a corps of volunteer lake monitors.
- Maintenance of the Indiana CLP website.
- Technical assistance and expertise on lake-related issues.

The CLP also works to develop educational materials such as brochures and fact sheets and conducts education and outreach through its quarterly newsletter and participation in the Indiana Lakes Management Society Conference each year. The program holds workshops each year to help increase public understanding of the important zones of a lake that provide essential habitat and ecosystem services. Volunteers that participate in the workshops often expand their monitoring efforts becoming even better lake stewards. This program has been very well received and continues to improve with each workshop. In 2012, IU-SPEA expanded its volunteer monitoring program to include aquatic invasive species monitoring with the goal of improving early detection and prevention of the spread of invasive species. In 2014, zebra mussels were added to the program.

Volunteers enter the data they collect on the CLP website at: www.indiana.edu/~clp/index.php. Volunteer data reports are available on the website for the years 1999-2011. Information regarding IDEM's use of the data collected by IU-SPEA staff members and students for CWA Section 305(b) and Section 314 assessments can be found in a later section of this report.

COORDINATION AND COLLABORATION WITH OTHER AGENCIES AND ORGANIZATIONS

Nonpoint source (NPS) pollution ranges from urban sources to construction and agricultural run-off which makes cooperation essential across political boundaries and disciplines. Many local, regional, state, and federal agencies play an important role in addressing NPS pollution, especially at the watershed level. Various agencies in Indiana provide data, technical resources and grants to local watershed groups to assist with planning, infrastructure design review and implementation of best management practices (BMPs) to reduce and prevent NPS pollution. Through coordination and collaboration, the Indiana Department of Environmental Management (IDEM) and other agencies together can more effectively focus water quality protection efforts where they are needed most.

IDEM's Office of Water Quality (OWQ) partners both with individual agencies and organizations on some efforts and with multiple agencies on others, described in this report. IDEM also employs five watershed specialists that act as liaisons for local, state and federal entities to integrate watershed planning into local level planning efforts. These specialists serve as Section 319(h) project managers and assist in a technical, managerial and financial advisory role for local watershed groups. IDEM staff members in the Wetlands and Storm Water Programs work cooperatively with the U.S. Army Corps of Engineers (USACE), the Indiana Department of Natural Resources (IDNR), the U.S. Fish and Wildlife Service (USFWS), local soil and water conservation districts (SWCDs) and other agencies to provide technical assistance and issue Clean Water Act (CWA) 401 water quality certifications, state permits for isolated wetlands, and construction/land disturbance permits to protect water quality.

Indiana Department of Natural Resources

Division of Reclamation, Abandoned Mine Lands Program

IDEM's Total Maximum Daily Load (TMDL) and NPS Programs work with IDNR's Abandoned Mine Lands (AML) Program on TMDL development and potential water quality improvements in watersheds where abandoned coal mines exist. The AML Program contributes to these efforts by sharing water quality data and information regarding the costs and techniques involved in their reclamation projects. The AML Program has also helped to educate OWQ staff members about areas impacted by acid mine drainage by touring reclamation projects with them at different points in the reclamation process.

Division of Fish and Wildlife, Lake and River Enhancement Program

The goal of the Lake and River Enhancement (LARE) Program in the IDNR Division of Fish and Wildlife is to reduce the amount of sediment and nutrients entering Indiana's lakes and rivers. Coincidental to this goal is an ongoing effort to utilize LARE-funded projects to protect and enhance aquatic habitat for fish and wildlife to ensure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreation.

These goals are accomplished through the granting of state funds to eligible sponsoring entities to provide for technical and financial assistance to qualifying projects. These projects range from diagnostic studies of targeted sub-watersheds to determine the design and construction feasibility of measures to reduce erosion and sedimentation in lakes and streams. Indiana law dedicates a portion of LARE funding to the removal of sediment, logjams and other obstructions, and control of invasive aquatic species. The program also provides funding to county SWCDs to assist individual landowners in the use of best management practices (BMPs) in targeted watersheds.

In 2017, LARE grants totaled more than \$2.3 million to projects in several counties across the state. Funding for the program comes from a lake and river enhancement fee paid by boat owners annually to the Bureau of Motor Vehicles. LARE projects leverage these funds to benefit not only boaters but everyone who uses Indiana's publicly accessible lakes and streams. LARE-funded projects also help to improve aquatic habitat and reduce the amount of nutrients entering both the Great Lakes and the Mississippi River through Indiana streams.

Lake Michigan Coastal Program

The purpose of the IDNR's Lake Michigan Coastal Program (LMCP) is to enhance the state's role in planning for and managing natural and cultural resources in the coastal region and to support partnerships between federal, state and local agencies and other organizations. The LMCP annually awards grants through its Coastal Grants Program funded by the federal Coastal Zone Management Act to coastal municipalities, counties, nonprofit groups, and universities for projects that protect and restore natural, cultural and historic resources in Indiana's Lake Michigan coastal region. Examples of how these funds might be used include:

- Protection and restoration of significant natural and cultural resources.
- Programs to prevent the loss of life and property in coastal hazard areas.
- Improved public access for recreational purposes.
- Revitalized urban waterfronts and ports.
- Improved coordination among government agencies when making policy decisions.
- Pollution prevention initiatives, including NPS pollution into coastal waters.

During 2016 and 2017 the Lake Michigan Coastal Program awarded \$540,488 for water quality planning, outreach/education, research and improvement grants to communities, non-profit organizations, universities and schools across the Lake Michigan Watershed.

Indiana's Coastal NPS Pollution Control Program was established in 1990 by Section 6217 of the Coastal Zone Act Reauthorization Amendments, which is jointly administered by the National Oceanic and Atmospheric Administration (NOAA) and U.S. EPA. The program is part of Indiana's LMCP and received conditional U.S. EPA/NOAA approval in 2008, establishing a set of management measures to help states control and reduce polluted runoff to coastal waters from five main sources:

- Agriculture.
- Urban areas.
- Marinas and recreational boating.
- Hydromodification, including shoreline and stream channel modification.
- Wetlands, riparian areas, and vegetated treatment systems.

All coastal and Great Lakes states and territories that participate in the National Coastal Zone Management Program are required to develop coastal nonpoint pollution control programs. State authorities ensure implementation.

The LMCP is working closely with IDEM's NPS Program and other NPS program partners to implement management measures specified by U.S. EPA to prevent and mitigate NPS pollution in the Lake Michigan coastal watersheds. IDEM anticipates submitting documentation to indicate how Indiana meets all remaining Coastal NPS Pollution Control Program conditions to U.S. EPA/NOAA on or before September 30, 2019.

Of the 56 measures that Indiana's Coastal NPS Pollution Control Program must be implemented, only one remains to be developed and submitted for approval. This measure involves putting processes in place across the coastal watershed to ensure that septic systems are inspected and maintained on a regular basis to minimize pollution related to failing systems. In 2017, the Lake Michigan Coastal Program was awarded an IDEM Section 319 grant that will help in moving toward approval of this final measure. This grant involves three components:

1. Mapping septic systems within 500 feet of surface waters within Indiana's Lake Michigan Watershed.
2. *E. coli* monitoring and molecular source tracking efforts to better understand the impact of septic system pollution on surface waters.
3. A robust neighborhood-based outreach and education program targeted at homeowners in partnership with neighborhood ambassadors and realtors.

The outreach and education task will draw on materials developed in 2017 in collaboration with Save the Dunes and the Septic System Coordination Work Group. In 2016 and 2017, the SSCWG spearheaded adoption and promotion of U.S. EPA's SepticSmart Week by ISDH, IDEM, IDNR, and more than 40 coastal towns, agencies, and organizations. In 2017, the Governor issued a proclamation designating September 18-22, 2017 SepticSmart Week in the State of Indiana.

Indiana Conservation Partnership

IDEM is a member of the Indiana Conservation Partnership (ICP) – a partnership comprised of eight state and federal agencies and other organizations committed to the goal of promoting conservation. The ICP provides technical, financial, and educational assistance needed to implement conservation practices that are environmentally and economically compatible and that promote good stewardship of Indiana's soil and water resources. IDEM serves on the ICP with the following agencies and organizations:

- U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS).
- U.S. Department of Agriculture Farm Service Agency (USDA-FSA).
- State Soil Conservation Board.
- Indiana State Department of Agriculture (ISDA).
- Indiana Department of Natural Resources (IDNR).
- Indiana Association of Soil and Water Conservation Districts (IASWCD).
- Purdue University Extension.

The ICP meets bimonthly for partner updates and to coordinate and collaborate where possible to optimize their resources – particularly their various cost-share and grant programs and technical training for achieving water quality objectives. The ICP also prepares an annual work plan that defines objectives for up to four conservation focus areas and includes the actions, responsible entities and deadlines for achieving them.

The ICP sponsors a number of initiatives that have the potential to improve water quality in Indiana. One example is INfield Advantage (www.infieldadvantage.org), which provides the opportunity to gather and analyze field-specific data. Through peer-to-peer group discussion and local aggregated results, INfield Advantage's tools help farmers in the following ways:

- Understand and evaluate unbiased, individualized data.
- Make more informed decisions by utilizing INfield Advantage insights to compare and implement management opportunities that optimize inputs and improve profits.
- Improve soil health and water quality.

Many agencies participating in the ICP also provide funding on a limited or continuing basis to address NPS pollution such as with NRCS's Regional Conservation Partnership Program and ISDA's Clean Water Indiana program.

State Nutrient Reduction Strategy

Indiana's State Nutrient Reduction Strategy – a collaborative effort between ISDA, the lead agency and Gulf Hypoxia Task Force member, and IDEM with contributions from other ICP partners – was revised in 2016 to provide a framework for reducing nutrients entering Indiana waters. As part of this strategy, the ICP has committed to report load reductions of sediment, nitrogen, and phosphorus achieved by the practices installed under the various funding authorities of its participating agencies. ISDA technicians use the U.S. EPA model to calculate load reductions. Cumulative load reductions for calendar years 2013 through 2017 follow:

- Sediment – 1,372,892 tons.
- Nitrogen – 2,841,449 pounds.
- Phosphorus – 1,407,346 pounds.

Indiana's State Nutrient Reduction Strategy (revision due December, 2018) along with watershed story maps and ICP accomplishments may be found at: www.in.gov/isda/2991.htm. More detailed information about the ICP and its activities can be found at: wordpress.iaswcd.org/

U.S. Department of Agriculture, Natural Resource Conservation Service

National Water Quality Initiative

USDA annually targets Farm Bill dollars to the NRCS National Water Quality Initiative (NWQI) Monitoring Projects watersheds to promote the implementation of conservation practices. IDEM worked closely with NRCS to prioritize watersheds for the NWQI using the decision criteria of watersheds with impaired waters, high risk natural resource areas, active local watershed groups or conservation interests, and baseline water quality data. As a partner on the NWQI, the U.S. EPA requires IDEM, as the state agency in Indiana charged with implementing the CWA, to contribute monitoring resources to at least one NWQI watershed.

The watershed selected for NWQI monitoring is the School Branch watershed, a small (8.4 square miles) watershed located in northeastern Hendricks County, Indiana. School Branch is nested in the Eagle Creek watershed, which is located in the larger Upper White River Watershed. Land use in the watershed is predominately agricultural with interspersed residential areas. Soil classes in the School Branch watershed are predominantly poorly drained and the watershed is extensively tile drained. School Branch eventually drains into Eagle Creek Reservoir, a primary drinking water source for Indianapolis.

School Branch, Eagle Creek, and the Upper White River watersheds are on Indiana's 303d List of Impaired Waters due to high levels of nutrients. The size of the Eagle Creek and Upper White River watersheds (163 and 2,718 square miles, respectively) and the variety in land uses at these scales has made it difficult to evaluate the effects of conservation and land management strategies. Therefore, focusing on the much smaller School Branch watershed, in which 80 percent of the land use is agricultural will allow researchers to adequately isolate water quality impacts from agriculture versus other sources. Previous attempts to document water quality improvements from agricultural conservation practices at the watershed scale have proven particularly difficult due to the number of issues that could hinder the ability to attribute improvements to specific practices. These issues include:

- Insufficient baseline data.
- Incomplete separation of agricultural influences from non-agricultural sources.
- Inadequate sampling duration and intensity to account for "lag time", seasonal influences, and storm events.
- Insufficient adoption of complete conservation systems within watersheds.

A collaboration of federal, state, local, and academic entities along with dedicated conservation-minded farmers in the School Branch watershed has provided a unique monitoring opportunity to assess the chemical, physical, and biological impacts of conservation practices at the watershed, sub-watershed, and edge-of-field scales in the School Branch watershed. The project is currently measuring water quality associated with conservation cropping systems that improve soil health in predominantly corn and soybean row crop agriculture.

The data collected in this watershed will allow evaluation of how production agriculture can complement sustainable water resources. In addition, because the School Branch watershed is nested within two successively larger watersheds of similar land use and hydrology, the project is monitoring and can model impacts of conservation at multiple scales. Historical data is also available to enhance the assessment of improvements over time.

Monitoring and evaluation efforts continued in 2016 and 2017. These efforts are being conducted at different scales by IDEM, the USGS, the Indiana Geological and Water Survey (IGWS), the Marion County Health Department, USDA-NRCS, and the Center for Earth and Environmental Services at Indiana University - Purdue University, Indianapolis.

Through this monitoring – a collaborative effort without precedent in Indiana – these agencies and organizations are measuring streamflow and groundwater levels, collecting water samples from the stream and edge-of-field surface runoff, and monitoring sub-surface flows. A tile drain synoptic study has been initiated to gain a better understanding of the hydrology and nutrient transport within the study area. Groundwater is also being monitored for nitrogen and phosphorus. Soils are being monitored as well, to determine moisture levels, water-holding capacity, and nutrient content. Supplementary biological indicators will be used to evaluate factors affecting water quality and nutrient source tracking from field, in-stream bed and bank, and residential sources and sediment characteristics analyses will be conducted.

Thanks to conservation-minded farmers participating in this study, the research partners collaborating on this project will be better able to distinguish between the water quality effects associated with complete conservation cropping systems from other agricultural and non-agricultural sources of sediment and nutrients.



Indiana Water Monitoring Council

[The Indiana Water Monitoring Council \(InWMC\)](#), is a broad-based, state-wide organization whose primary mission is to enhance the communication, collaboration and coordination of professionals, organizations, and individuals involved in water monitoring within Indiana. As a charter member, IDEM has remained actively involved with the InWMC, maintaining a presence on the board of directors and participating in committees to assist with activities that:

- Provide a forum for communication among groups involved in monitoring Indiana waters.
- Promote the sharing of monitoring data and information on effective procedures and protocols for sample collection.
- Facilitate the development of collaborative monitoring strategies.

The InWMC supports communication, collaboration, and coordination about monitoring across the full spectrum of water resources – both surface water and ground water – from multiple perspectives including water quality, water quantity, ecology, and human health. For example, the InWMC’s [Ground Water Focus Committee](#) is currently working on initiatives to better understand and educate people on the issues of arsenic and nitrogen in groundwater, to promote soil moisture monitoring throughout the state to better understand the role soil moisture plays in Indiana’s [hydrologic water budget](#), and to provide private well owners with resources to help them learn about their water supply and how to protect it.

Shortly after the InWMC’s formation, its Coordination and Collaboration Committee, now known as the [Data Optimization Committee](#), convened the Integrated Water Monitoring Network Optimization Taskforce to work toward a better understanding of water quality monitoring efforts throughout the state.

Multiple state, federal, and local agencies and organizations monitor water quality within Indiana, each with its own mandate or reason for monitoring. Although each agency and organization is collecting potentially valuable data on Indiana’s water resources, the lack of coordination can lead to duplication of efforts and important information that may be overlooked from the lack of data sharing.

Members of the InWMC have overwhelmingly cited the need for a shared understanding of existing, active monitoring networks within Indiana among the water resources community as being critical to

more effective management of water resources throughout the state. In 2017, the InWMC published the findings of the taskforce on the InWMC website in a paper entitled, [*An Assessment for Optimization of Water-Quality Monitoring in Indiana*](#)—a study of ongoing monitoring networks throughout Indiana to help environmental managers, researchers, and interested citizens find data from sampling sites with long periods of record. The study highlights the existing river and stream water quality monitoring networks, including IDEM’s, that can provide data and identify new sites that may be needed to augment existing networks and/or eliminate sites that are currently being monitored by more than one group.

The InWMC has also published its inaugural issue of the [*Indiana Water Report*](#) for 2017, which describes current water-related monitoring and research going on throughout the state. The report is intended to help those working to manage water resources in Indiana do so more effectively and with a fuller understanding of how their efforts fit into the larger picture and to support great communication and collaboration wherever possible.

Indiana Finance Authority

IDEM assists the Indiana Finance Authority in the administration of the Indiana State Revolving fund (SRF) Loan Program, which offers two different loan programs that provide low-interest loans to Indiana communities, one for projects that improve drinking water and the other for wastewater infrastructure projects. The purpose of these programs is to protect public health and the environment. Cities, towns, counties, regional sewer/water districts, conservancy districts are eligible to apply for either program. Private and not-for-profit public water systems and water authorities are eligible for drinking water SRF loans.

Eligible projects include those that abate water pollution problems, provide greater protection for public health or ensure compliance with either the CWA or the Safe Water Drinking Act. Wastewater projects may include wastewater treatment plant construction or improvements, sewer line extensions to existing unsewered areas, decentralized treatment systems, combined sewer overflow elimination and infiltration/inflow corrections. Drinking water projects may include treatment plant construction and improvements, water storage facilities, water distribution systems and water supply. The program provides additional financial incentives to projects to include green technology, a Brownfields program² project or a sustainable infrastructure component.

Both SRF Loan Programs offer a 20-year, fixed rate loan term. Interest rates on these loans use a base interest rate, which is reset on the first business day of each January, April, July and October. The base rate is calculated by using 90 percent of the average 20-year AAA-rated, general obligation bond Municipal Market Data composite index for the most recent calendar month. The base rate is then discounted further based upon a borrower’s median household income from the current American Community Survey data 5-year estimate and projected user rates. As an incentive to communities to address nonpoint source water pollution, for projects with a NPS component or green/sustainable infrastructure components, the interest rate on their loan may be reduced by up to 0.5 percent. The program established a floor of 2-percent for the lowest interest rate, including any reductions.

²The Indiana Brownfields Program works in partnership with the U.S. Environmental Protection Agency and other Indiana agencies to assist communities with redevelopment of “brownfield” properties where making productive use/redevelopment is complicated due to actual or potential environmental contamination.

The SRF Loan Programs coordinate with state and federal programs, including IDEM's OWQ, to identify ways it might provide assistance to Indiana communities that will ultimately help to achieve common goals. For example, the Clean Water SRF ranking and scoring gives additional points for projects that remove a pollutant source from an impaired stream. This way of scoring increases the likelihood that projects with a water quality benefit will rank high on the SRF project priority list. The funds loaned for these removal projects can be documented as a match, when applicable, for the projects submitting grant proposals to the NPS Program. Projects eligible for match must provide water quality benefits to their respective communities and may include, but are not limited to, one or more of the following:

- Wetland restoration/protection.
- Erosion control measures.
- Groundwater remediation.
- Repair or replacement of failing septic systems or connection to sewer.
- Storm water BMPs.
- Source water and wellhead protection.
- Conservation easements.
- Agricultural and waste management BMPs.

The SRF Loan Program also serves on the Indiana Rural Wastewater Task Force's Environmental Infrastructure Working Group, which allows the SRF Program the opportunity to provide input and offer financing options to communities for their drinking water and/or wastewater infrastructure needs. The SRF Loan Programs work with communities addressing combined sewer overflows, enforcement issues or those with or nearing a sewer ban.

Over the State Fiscal Years (SFYs) 2016 and 2017, four projects with a NPS component saved an additional \$17,916,274 over the 20-year term of their loans. While these savings are realized over the longer term, these projects are typically completed within two years and the water quality benefits are achieved much sooner than 20 years.

Indiana's Great Lakes Water Quality Agreement Domestic Action Plan

Indiana's Great Lakes Water Quality Agreement (GLWQA) Domestic Action Plan (DAP) to reduce phosphorous to the Western Lake Erie Basin was released February 28, 2018. It is the product of an Advisory Committee comprised of representatives from various stakeholder sectors and led by IDEM. Founded on the principle of adaptive management, the DAP is a dynamic document acknowledging that nutrient pollution in general, and phosphorous loading in particular, is a very complex problem caused by point and nonpoint sources across all sectors, and requires a multi-dimensional solution.

The DAP emphasizes using existing programs and optimizing partnerships, effecting the most change with the least cost, prioritizing resources to areas with the most phosphorus export and/or reduction potential, seeking to engage citizens who are not participating in conservation efforts, making use of social indicators to guide actions, and employing adaptive management.

Indiana's goal is to meet the spring-time phosphorus targets for the Maumee River as it flows across the border into Ohio. The DAP includes an Action/Milestone table that enumerates the current and planned activities to address the issues outlined in the DAP as well as an adaptive management plan.

COST/BENEFIT ASSESSMENT

Water is a vital component of the economic health of Indiana, which is diverse in its agriculture, industry, population, and environmental resources. Finding the right balance between these often competing needs creates the benefits associated with a robust economy, high quality of life, and healthy ecosystems. However, the finances available to restore, enhance, and protect our water resources is limited in comparison to the work needed to ensure that balance. The following is a discussion of some of the revenue sources available to state, regional, and local entities to achieve the objectives of the Clean Water Act (CWA) as well as case studies that illustrate improvements in water quality and their resulting benefits.

Funding Water Quality Improvements through Better Infrastructure

Since 1992, the State Revolving Fund (SRF) Programs have provided more than \$4.2 billion dollars for more than 736 wastewater (Figure 2, Appendix B) and drinking water (Figure 3, Appendix B) infrastructure improvement projects. SRF Program assistance to communities is expected to result in water quality benefits for many Indiana rivers and streams.

In state fiscal years (SFYs) 2016 and 2017, the Wastewater SRF Program closed 35 loans totaling over \$436 million. This provided an estimated savings (compared to open market interest rates) of more than \$96 million. In SFYs 2016 and 2017, the Drinking Water SRF Program closed on 22 loans totaling over \$63 million with savings to Indiana communities estimated at more than \$20 million (Table 6, Appendix A).

Successes in Water Quality Improvement through Strategic Measures

The Indiana Department of Environmental Management (IDEM) has reported improvements in water quality in more than 250 miles of streams in 15 different watersheds since 2007 to the U.S. Environmental Protection Agency (U.S. EPA) to meet measures outlined in U.S. EPA's strategic plan (Table 5). Measure SP-12 (commonly called "Measure W") is used by U.S. EPA to track improvements in water quality conditions in impaired watersheds resulting from watershed planning and restoration activities. For the purposes of meeting this measure, improvements may be demonstrated by the removal of at least 40 percent of the impairments or impaired miles/acres in the watershed from the state's 303(d) List of Impaired Waters or by valid scientific information that indicates significant watershed-wide improvement in one or more water quality parameters associated with the impairments listed on Indiana's 2002 303(d) list. WQ-10a is a performance measure that requires states to develop Nonpoint Source (NPS) Program "Success Stories" and submit them to U.S. EPA for the purposes of tracking how NPS restoration efforts are improving water quality. To meet this measure, IDEM must identify nonpoint source-impaired waters that have been improved as a result of watershed restoration efforts undertaken in whole or in part by IDEM's NPS Program.

In 2016 and 2017, IDEM reported water quality improvements in Flowers Creek, Pendleton Branch of Indian Creek, and Buck Creek-Busseron Creek watersheds. These successes and others can be found on U.S. EPA's Nonpoint Source Success Stories [website](#).

Restoring the Aquatic Community in Flowers Creek

Flowers Creek is a 12.72-mile-long tributary of the Eel River in north-central Indiana (Figure 4, Appendix B). The Eel River, which is well-known for its smallmouth bass fishery, is designated as an outstanding river for 63 river miles. Monitoring conducted by IDEM in 2003 on Flowers Creek showed elevated levels of total phosphorus and ammonia in conjunction with low dissolved oxygen and impaired biotic communities. On the basis of these data, Flowers Creek was listed as impaired for nutrients, dissolved oxygen and biological impairments in 2006.

In late 2008, Manchester University's Department of Environmental Studies obtained a CWA Section 319(h) grant to support watershed planning and restoration for the Middle Eel River watershed, which includes Flowers Creek. They developed a watershed management plan (WMP), promoted and implemented a cost-share program for best management practices (BMPs), and conducted water quality monitoring and public outreach.

Federal, state and local partners supported restoration efforts. The United States Department of Agriculture (USDA) provided \$968,585 through the Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP) and the Wildlife Habitat Incentives Program (WHIP) to install BMPs. More than \$1 million of CWA Section 319(h) funding was provided by IDEM and the Indiana State Department of Agriculture (ISDA) for the initiative. Manchester University provided \$733,333 in local match funding. Miami County Soil and Water Conservation District (SWCD), the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) program, and ISDA provided nearly \$135,000 in cost share funding to implement BMPs.

IDEM resampled Flowers Creek in 2015. Post-project sampling showed that the biological communities had recovered. Based on these results, Indiana is proposing to remove Flowers Creek from its impaired waters list in 2018.

Impairments Removed in the Pendleton Branch of Indian Creek

Indian Creek is a 22-mile-long Ohio River tributary in western Switzerland County, Indiana (Figure 5, Appendix B). IDEM listed the Pendleton Branch of Indian Creek on its 2008 CWA Section 303(d) List of Impaired Waters due to high levels of *Escherichia coli*. Bioassessment data collected in 2010 prompted the addition of an aquatic life use impairment in 2014.

To address these concerns and others, partners developed and implemented the Indian Creek Watershed Management Plan under the guidance of the nonprofit Historic Hoosier Hills Resource Conservation and Development Council. The plan was completed in 2008.

A variety of federal, state and local partners contributed to restoration in the watershed (Table 7, Appendix A). Historic Hoosier Hills coordinated the WMP planning and implementation events. IDEM awarded \$916,167 in CWA Section 319(h) funding to the effort. Switzerland County Soil and Water Conservation District sponsored the Section 319(h) grant for the WMP, obtained a Clean Water Indiana grant totally \$122,983 from the ISDA to conduct outreach and install BMPs, obtained and administered more than \$26,000 in local funds from Switzerland County to provide cost-share for BMPs, and was the technical service provider during implementation. NRCS provided BMP promotion, design and installation at a cost of \$1,024,471 through both its Environmental Quality Incentives Program and its Wildlife Habitat Incentives Program. FSA contributed \$6,824 toward BMP design and installation through its Conservation Reserve Program.

IDEM resampled the reach for *E. coli* in 2011 and found that it had improved. As a result, IDEM removed Pendleton Branch of Indian Creek from the impaired waters list in 2014 for *E. coli*. In 2015, after significant restoration work had taken place, IDEM sampled the aquatic community and found that macroinvertebrates had also recovered. Therefore, IDEM is proposing the Pendleton Branch of Indian Creek for removal from the 2018 impaired waters list.

Nutrient Impairments Corrected in the Buck Creek-Busseron Creek Watershed

The Buck Creek-Busseron Creek watershed is located in Sullivan County in southwest Indiana (Figure 6, Appendix B). Nutrient parameters were sampled in the watershed in 1999 and 2000. This sampling revealed an elevated level of phosphorus in both Buck Creek and Robbins Branch. As a result, IDEM listed nearly 27 stream miles in the watershed on its CWA Section 303(d) List of Impaired Waters in 2002. In addition to elevated phosphorus levels, dissolved oxygen was found to be low in Buck Creek and Robbins Branch. However, it was not low enough to prompt an official impairment listing. Further monitoring in 2006 revealed that aquatic community scores were not achieving target benchmarks, so impaired biotic communities was also to Indiana's Section 303(d) impaired waters list in 2010.

From 2003 through 2015, multiple federal, state, and local partners collaborated to restore the watershed. The Sullivan County SWCD spearheaded an effort to create and implemented a WMP for the Busseron Creek watershed. The WMP was complete in 2010. Landowners installed numerous BMPs in the watershed that improved water quality.

IDEM provided nearly \$800,000 in CWA Section 319(h) grants to the Sullivan County SWCD, which coordinated planning and restoration work in the watershed and provided more than \$600,000 in landowner and in-kind match. The USDA provided more than \$400,000 in EQIP, WHIP, CRP, and Conservation Stewardship Program funds to install BMPs. The ISDA also provided more than \$20,000 in state funding for marketing, education programs, technical assistance and BMPs.

IDEM reassessed the water quality in the Buck Creek-Busseron Creek watershed in 2016 (Table 8, Appendix A). Sampling revealed that applicable nutrient and biologic community water quality standards are now being met. As a result, Indiana is proposing to remove three waterbodies in the Buck Creek-Busseron Creek watershed from its 2018 CWA section 303(d) impaired waters list.

Grand Calumet River Indiana Harbor Ship Canal Area of Concern Remedial Action Plan

The Grand Calumet River, located in Lake County in far northwestern Indiana, is a complex river system that has been heavily modified by people. It is made up of two east-west oriented branches that meet at the southern end of the Indiana Harbor Ship Canal (IHSC). The IHSC, in turn, extends north from its junction with the East and West branches of the Grand Calumet River to the Indiana Harbor. The Lake George Branch is a two-mile east-west branch of the IHSC.

Prior to the adoption of strict environmental regulations under the CWA, industries and municipal sanitary districts commonly discharged chemicals and contaminants directly into the Grand Calumet River and the IHSC. Such pollution, which consisted of oils and greases, heavy metals, human waste, and other industrial chemicals, accumulated in the sediments at the river bottom and along the adjacent wetlands. This accumulated pollution caused drastic harm to the ecosystem and reduced the ability of the river system to provide several beneficial ecosystem services, such as clean water for drinking, wading, and industrial use; healthy fish and wildlife; and healthy, aesthetically-pleasing environments.

By the 1970s, new environmental regulations changed how municipalities and industries could operate. This drastically reduced the amount of contaminants being discharged into the river. However, even with new operational standards, legacy contaminants – those discharged prior to the change in regulations – continued to cause great harm to the river. Moreover, the impaired Grand Calumet River had the potential to reduce the water quality of the Great Lakes as a whole through its connection to Lake Michigan at the Indiana Harbor. The area, which also includes Wolf Lake, Lake George, and portions of the Indiana Lake Michigan shoreline, also faced numerous threats to native habitat from non-native invasive species. This combination of factors led the International Joint Commission (IJC), a binational organization made up of representatives of the United States and Canada, to list the region as one of 43 designated Areas of Concern (AOCs) within the Great Lakes Basin.

The United States and Canada, under the 1987 Great Lakes Water Quality Agreement (GLWQA), required, for all AOCs including the Grand Calumet River/Indiana Harbor Ship Canal AOC, the development of a Remedial Action Plan (RAP) to serve as a blueprint for the restoration of critical ecosystem services. The goal of the RAP is to identify the remedial actions necessary for removing each of the following 14 designated beneficial use impairments (BUIs):

1. Restrictions on fish and wildlife consumption.
2. Tainting of fish and wildlife flavor.
3. Degradation of fish and wildlife populations.
4. Fish tumors or other deformities.
5. Bird or animal deformities or reproduction problems.
6. Degradation of benthos (bottom-dwelling organisms).
7. Restriction on dredging activities.
8. Eutrophication or undesirable algae.
9. Restrictions on drinking water consumption, or taste and odor problems.
10. Beach closings.
11. Degradation of aesthetics.
12. Added costs to agriculture and industry.
13. Degradation of phytoplankton and zooplankton populations.
14. Loss of fish and wildlife habitat.

In Indiana, it was decided that IDEM would take the lead in developing the RAP for the Grand Calumet River AOC. IDEM then appointed a group of individuals representing a diverse set of regional stakeholders to the Citizens Advisory for the Remediation of the Environment (CARE) Committee. Since 1990, the CARE Committee has provided valuable input into the RAP planning process.

The RAP identifies key projects needed to remove the 14 BUIs impacting the Grand Calumet River AOC. These include: management of contaminated sediment for the entire river system, restoration of over 900 acres of native dune and swale and wetland habitat, and reduction of *E. coli* sources resulting in beach closures at AOC beaches. Funding to carry out these projects has been provided by the Great Lakes Legacy Act (GLLA), Great Lakes Restoration Initiative (GLRI), Natural Resource Damages settlements, and other state and local sponsors.

As a result of these partnerships, significant progress has been made toward the RAP sediment management goals. Since 2002, more than 3.25 million cubic yards of contaminated sediments containing heavy metals, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) have been removed. Combined sewer overflows (CSOs) in the system have been reduced through the construction of a CSO basin in Hammond, which has enhanced water quality and aesthetics along the West Branch of the Grand Calumet River. Water quality sampling has shown that continued CSO abatement in Hammond, Gary, and East Chicago will further improve water quality as these communities implement their long-term control plans.

Habitat restoration has also been a priority for the RAP partnerships, with GLLA projects completing restoration of 84 acres of wetland and riverine marshes, including Roxana Marsh in East Chicago, Indiana and Seidner Dune and Swale in Hammond, Indiana. In addition, the GLRI is funding the restoration of more than 900 acres of State- and locally-managed habitat throughout the AOC by 2020. Managed properties such as Clark and Pine Nature Preserve, DuPont Natural Area, and Gibson Woods Nature Preserve protect globally-rare dune and swale and other habitats in which some of the largest concentrations of threatened and endangered species are found in the State.

Monitoring throughout the restoration process is essential to ensure work is on track to meet restoration goals. IDEM has implemented monitoring projects to assess plant, fish, benthic, and plankton communities; water chemistry; and aesthetics within the AOC. In addition, the agency has provided GLRI funds to universities and federal agencies to conduct microbial source tracking at AOC beaches.

In 2011 and 2012, respectively, BUI #12 (Added costs to agriculture and industry) and BUI #9 (Restrictions on drinking water consumption, or taste and odor problems) were removed from the list of impairments for the Grand Calumet River AOC. IDEM and the CARE Committee are working diligently to design and implement the remaining management actions necessary to remove the 12 remaining BUIs and remove the Grand Calumet River/Indiana Harbor Ship Canal AOC from the list of AOCs maintained by the IJC, a process known as delisting. Currently, IDEM is working toward the goal of having all habitat-related management actions completed, and all other management actions identified, by the end of 2020. Currently, IDEM plans to have all management actions necessary for BUI removal completed by the end of 2022.

SPECIAL STATE CONCERNS AND RECOMMENDATIONS

Reductions in federal and state resources for data collection and analysis coupled with increased federal directives and competing policy and program objectives continue to strain the ability of the Indiana Department of Environmental Management to optimize its limited resources to monitor Indiana waters in order to support Office of Water Quality (OWQ) programs and emerging state priorities.

IDEM acknowledges that fiscal responsibility may necessitate reductions in funding and staffing levels. In light of these constraints, IDEM recommends the following actions:

- Increase states' flexibility to allocate the federal funding it receives to take advantage of and optimize other funding sources.
- Combine supplemental and base funding to states provided through CWA Section 106 funds so



that in lean times, maintaining current monitoring efforts may be considered by the U.S. Environmental Protection Agency (U.S. EPA) is a valid use of supplemental funds.

- Acknowledge the continuum of progress demonstrated by social indicators or other factors in addition to measurable water quality improvements.

SURFACE WATER MONITORING AND ASSESSMENT

The Indiana Department of Environmental Management (IDEM) conducts most of its surface water monitoring through various programs in the Watershed Assessment and Planning Branch (WAPB). This section includes a discussion of IDEM's surface water monitoring strategy, a description of the assessment methodology for classifying all surface waters according to the degree to which they meet their designated uses, and the most current assessment results available. This section also provides a description of Indiana's surface water monitoring strategy, an analysis of surface water quality trends and information on public health issues.

IDEM'S SURFACE WATER MONITORING STRATEGY

The mission of the Office of Water Quality (OWQ) at the Indiana Department of Environmental Management (IDEM) is to monitor, protect, and improve Indiana's water quality to ensure its continued use as a drinking water source, habitat for wildlife, recreational resource and economic asset. The OWQ has developed a water quality monitoring strategy (WQMS) to support this mission and to facilitate an adaptive management process that helps to ensure that its monitoring programs are providing the data required by OWQ's programs and to meet emerging concerns.

The U.S. EPA recommends ten elements that states should include in their water monitoring strategies in order to meet prerequisites of the federal Clean Water Act (CWA) Section 106 (U.S. EPA, 2003). The new *Indiana Water Quality Monitoring Strategy, 2017-2021* refines the previous *Indiana Water Quality Monitoring Strategy 2011-2019*, which marked a significant change in monitoring designs. It was developed by an interdisciplinary work group comprised of staff members from several programs within the OWQ, including monitoring staff members responsible for collecting the water quality data needed to meet IDEM water management needs. OWQ's monitoring activities include the following programs:

- Probabilistic monitoring in one basin per year on a nine-year rotating basin cycle (Figure 1, Appendix B).
- Fixed Station monitoring at 165 sites across the state (two added in 2014 to support the Natural Resource Conservation Service National Water Quality Incentive program).
- Fish tissue and sediment contaminants monitoring on a five-year rotating basin cycle.
- Targeted (watershed characterization) monitoring for total maximum daily load (TMDL) reassessments and development, watershed baseline planning, and performance measures determinations.
- Cyanobacteria monitoring of 10-12 lakes and one dog park lake.
- Special studies, reference site monitoring, and remediation follow-up sampling.
- Thermal verification studies.
- Hoosier Riverwatch (HRW) program citizen volunteer monitoring.

OWQ's contracts with the Indiana University School of Public and Environmental Affairs to administer the Indiana Clean Lakes Program (CLP). The Indiana CLP, which is discussed in more detail later in this report, provides most of the lakes data OWQ needs for its programs. Through these programs,

OWQ collects surface water quality, biological, and habitat data to help meet one or more of the following objectives, which are included in the WQMS (Appendix A, Table 9):

- To fulfill requirements of the CWA Sections 305(b), 303(d) and 314 to assess all waters of the state to determine if they are meeting their designated uses and to identify those waters that are not.
- To support OWQ programs including WQS development, NPDES permitting, and compliance.
- To support public health advisories and address emerging water quality issues.
- To support watershed planning and restoration activities.
- To determine water quality trends and to evaluate the performance of programs.
- To engage and support a volunteer monitoring network across the state.

In general, the monitoring activities related to U.S. EPA priorities or requirements and those related to the protection of human health are ranked as IDEM's primary priorities. All others are ranked as secondary priorities based on resource constraints and other factors including the degree to which they meet the OWQ mission.

DATA QUALITY ASSURANCE AND QUALITY CONTROL

To ensure the quality of the data used in the Indiana Department of Environmental Management's (IDEM's) Clean Water Act Section 305(b) assessments, all surface water monitoring is conducted in accordance with IDEM's quality assurance project plan (QAPP) for its surface water monitoring programs. This QAPP is part of IDEM's overall quality management plan approved by the U.S. Environmental Protection Agency (U.S. EPA). IDEM's surface water monitoring QAPP was most recently revised in March 2017 and complies with the 2002 U.S. EPA guidance (U.S. EPA, 2002).

The QAPP outlines specific data quality objectives and serves as a tool for planning for the collection of environmental data to support IDEM Office of Water Quality needs. Additionally, the QAPP describes a well-defined data quality assessment process for reviewing analytical data and categorizing analytical results in one of four levels of data quality. These data quality levels are used to determine the usability of the data for water quality assessments and other decisions.

DATA MANAGEMENT

Management of Water Quality Monitoring Data

The Watershed Assessment and Planning Branch (WAPB) in the Indiana Department of Environmental Management's (IDEM's) Office of Water Quality (OWQ) maintains its surface water quality data in the Assessment Information Management System (AIMS) database. AIMS houses several types of data including surface water chemistry data, fish and macroinvertebrate community data, assessments of habitat quality, results from algal monitoring, and fish tissue and sediment contaminant data.

Water chemistry and fish community results from water quality monitoring programs which were collected prior to 2017 have been uploaded into the new U.S. Environmental Protection Agency (U.S. EPA) EnviroFacts Data Warehouse through the Water Quality Exchange (WQX). IDEM is continuing modifications to the AIMS database that will improve quality control and usability of results uploaded through the WQX.

Recent modifications to the AIMS database now allow for more efficient datasheet upload and retrieval with additional search functions for faster query building through a user-friendly interface for staff members. AIMS also now allows for storage of additional water quality data from NPS projects (including estimated load reductions) and third-party datasets for potential use in assessing waters for the integrated report. IDEM is now receiving data from Nonpoint Source (NPS) Program projects for import into the AIMS database. IDEM has developed standard operating procedures for receiving, assessing, and importing water quality data from third-party sources to make them more readily available for potential use in IDEM's water quality assessments.

The load reduction estimates provided by the NPS project sponsors, which are housed in AIMS and reported to U.S. EPA through its Grants Reporting and Tracking System, are included in this report (Table 4). The load reductions are estimated using models and are used to assist in the evaluation of water quality sampling data collected by the project sponsors and IDEM WAPB staff members.

Management of Water Quality Assessment Information

IDEM's WAPB currently maintains an assessment database (ADB) to house the CWA Section 305(b) assessment decisions that have been made on the basis of water monitoring data (physical, chemical and biological monitoring results) stored in the AIMS database.

In the ADB, water quality assessment information is associated with a specific waterbody assessment unit (AU), which is assigned a unique assessment unit identifier (AUID). The geographical extent and location of each AU within a given watershed based on its 12- or 14-digit HUC is defined for mapping purposes through a process called reach indexing. Reach indexing uses tools that work within geographical information systems (GIS) software to associate one or more reaches of a given waterbody to a single AU and to "key" these AUs to the National Hydrography Dataset (NHD)³. This "key" is called the Reach Index. By associating the information in the ADB to its geographic location, the Reach Index allows IDEM to display assessment information on a map through the use of GIS software.

IDEM embarked on a plan to upgrade its medium-resolution Reach Index (1:100,000) to a high-resolution Reach Index (1:24,000) in 2008. In 2016, IDEM had completed the task of revising the Reach Index to incorporate the high resolution NHD for the entire state and reported in the 2016 Indiana Integrated Water Monitoring and Assessment Report (IR) that the next step was to finalize the Reach index. In 2017, Indiana completed a thorough quality assurance review of the new Reach Index to ensure consistency in the application of indexing decision rules across all basins and to identify and make necessary corrections. IDEM anticipates little change to this index in future years.

In the Reach Index, Indiana lakes and reservoirs, including Lake Michigan, are each treated as a single AU and assigned an AUID based on the 12- or 14-digit watershed in which they are located. Sizes are reported in acres.

³ The NHD is a database created by the U.S. EPA and the United States Geological Survey that provides a comprehensive coverage of hydrographic data for the United States. It uniquely identifies and interconnects the stream segments that comprise the nation's surface water drainage system and contains information for other common surface waterbodies such as lakes, reservoirs, estuaries, and coastlines.

Indiana's Lake Michigan shoreline is divided into five separate AUs with AUIDs based on the 8-digit HUC in which each shoreline reach is located. The shoreline is measured and reported in miles.

All flowing waters are measured and reported in miles. The Ohio River is divided into 69 AUs ranging in size between 2-14 miles and with AUIDs that are likewise associated with the 8-digit HUCs in which they are located. Other Indiana rivers and streams in the Reach Index may be divided or combined into one or more AUs, each of which is assigned an AUID based on the 12-digit HUC in which it is located. The length of a stream AU can vary, and a single AU may or may not represent the entire stream to which it is associated. For example, large rivers are commonly broken into smaller, separate AUs while smaller streams may be grouped together into a single "catchment" AU based on hydrology and other factors that can affect water quality. More detailed information on how IDEM determines the size extent of a given AU is provided in its Consolidated Assessment and Listing methodology (CALM) (Appendix G).

In the past, IDEM's biennial Integrated Report to U.S. EPA has included the ADB. U.S. EPA extracts the data contained in the ADB for incorporation into its [Assessment, TMDL Tracking and Implementation System](#) (ATTAINS). ATTAINS is a national database U.S. EPA uses to evaluate assessment data submitted by states and to make those data available to the public online.

Currently, the information available for Indiana in ATTAINS is significantly outdated. However, IDEM anticipates this to change in the near future. As part of its effort to streamline water quality assessment and reporting, U.S. EPA has made significant enhancements to ATTAINS. These changes make ATTAINS a better choice for IDEM's water quality assessment data management than the ADB, which is no longer supported by U.S. EPA.

While much of the information in this report was extracted from the ADB, IDEM is currently in the process of working with U.S. EPA to upload the information contained in the ADB to the new ATTAINS database for the 2018 cycle. Once IDEM's data has been uploaded, IDEM will working with U.S. EPA to make any corrections needed in ATTAINS to achieve consistency between both agencies' records and to ensure the information presented online for the public is up to date and accurate.

WATER QUALITY ASSESSMENTS

Indiana's water quality standards (WQS) provide the basis for the Indiana Department of Environmental Management's (IDEM's) Clean Water Act (CWA) Section 305(b) water quality assessments and are intended to protect the designated uses for Indiana waters. IDEM's water quality assessments determine the degree to which Indiana's waterbodies are supporting aquatic life use, recreational uses, and fishable uses. IDEM also assesses drinking water use support on surface waters that serve as a public water supply. There are additional uses for Indiana waters described in the state's WQS. However, IDEM limits its assessments to these four because the criteria in place to protect them are more stringent than those necessary to protect other uses. Thus, by protecting these uses, other uses such as agricultural and industrial uses are also protected.

Water Quality Data Used to Make Designated Use Assessments

IDEM uses all existing and readily available data to make its CWA Section 305(b) water quality assessments, including data collected by IDEM's water quality monitoring programs as well as external sources whenever possible. Internally, IDEM draws from the following monitoring programs:

- Probabilistic Monitoring Program.
- Fixed Station Monitoring Program.
- Contaminants Monitoring Program.
- Performance Measures Monitoring Program.
- Special Studies Program.
- Watershed Characterization Program.

In addition to the water quality data IDEM collects, the agency reviews data from other sources for potential use in its CWA assessments, including data collected through partnerships with other state and federal agencies and by nonpoint source grant projects, including the Indiana Clean Lakes Program.

IDEM is committed to making greater use of external data not only in its CWA Section 305(b) assessments but wherever possible in all its Office of Water Quality (OWQ) programs. On September 23, 2015, IDEM launched its External Data Framework (EDF) to provide a systematic, transparent, and voluntary means for external organizations to share the water quality data they collect with IDEM for possible use in its CWA assessment and listing processes and other OWQ programs.

IDEM is currently working with two organizations to share the water quality data they are collecting with IDEM:

- [The U.S. Army Corps of Engineers \(USACE\), Louisville District](#) has collaborated closely with IDEM through the EDF to collect macroinvertebrate community data on selected streams flowing into Brookville Lake and Cecil M. Harden Reservoir in 2017. IDEM recently received the data from the USACE in July 2018 and is currently reviewing it for potential use in OWQ programs. IDEM anticipates that this data set will meet all the data quality requirements necessary for use in its CWA sections 305(b)/303(d) assessment and listing processes and other OWQ programs that use biological data.
- [The Marion County Public Health Department \(MCPHD\)](#) in Indianapolis, Indiana is currently working with IDEM to share the results from its water quality monitoring program through the EDF. The MCPHD conducts ambient surface water monitoring for a variety of bacteria, physical, and chemical parameters and biological monitoring of macroinvertebrate communities at a number of sites throughout the county. IDEM received its first submittal of biological data from the MCPHD in July 2018 and is reviewing the data set to determine whether it meets the necessary requirements for use in one or more OWQ programs. IDEM anticipates expanding this collaboration to include MCPHD's bacteria and chemistry data in the near future.

In addition to working with the USACE and the MCPHD, IDEM also plans to contact early EDF participants in to determine their interest in working together to share their data through the more streamlined processes now available in the EDF, which will help to standardize their data sets so IDEM can more efficiently review them and determine their reliability for use in different OWQ programs.

IDEM continues to refine its internal review processes where secondary data are concerned. One of the biggest hurdles IDEM and other organizations face in using secondary data is evaluating whether the data set meets the agency's data quality requirements. Often, the quality assurance documentation that IDEM receives with secondary data sets is incomplete, missing key information needed to determine the reliability of the data.

To address this issue, IDEM is working to create a new tool to make developing a quality assurance project plan (QAPP) – a document that provides all the information IDEM needs to perform a thorough data quality review – easier for organizations interested in sharing their water quality data through the EDF.

IDEM's QAPP tool will provide a series of forms online that participants can work through in one or more sessions and which, when completed will provide a fully developed QAPP to support their monitoring efforts and provide all the information needed to determine the quality of the data they collect. Here are a few of the features this new tool will include:

- An online library full of materials linked to relevant sections of the QAPP that participants can use to better understand the content required in that section.
- An automated messaging system that streamlines communications so that participants can ask questions that are automatically keyed to the specific section of the QAPP they're working on so IDEM can more quickly address them
- A user-friendly interface with one-click submittal of the QAPP for IDEM review

IDEM anticipates this tool to be fully developed by the end of 2018 and plans to make it available on its website as soon as possible thereafter. This tool is expected to facilitate greater participation in the EDF, potentially providing more water quality data available for CWA 305(b) assessments.

External organizations can learn more about the EDF and how to participate on the agency's EDF website www.in.gov/idem/cleanwater/2485.htm. Those interested in sharing their water quality through the EDF may begin submitting data sets to IDEM in one of three ways through the Secondary Data Portal at www.hoosieriverwatch.com/portal/.

Water Quality Assessments at Two Spatial Scales

Much of the data IDEM collects and receives from external sources are reach-specific, meaning the results can be applied only to the waterbodies from which the samples were collected and for which they are representative. However, data collected by IDEM's Probabilistic Monitoring Program can be used to make water quality assessments of rivers and streams at two spatial scales – reach-specific assessments and basin-wide assessments.

Reach-specific Use Support Assessments

IDEM uses the data collected by the Probabilistic Monitoring Program to make use support assessments of the stream or stream reach from which they were collected and any other reaches for which the results are representative. For these assessments, the water quality data are compared to applicable water quality criteria to determine whether or not the reach or reaches represented by the data are supporting one or more of their designated uses. Results from IDEM's reach-specific assessments are summarized in the "Rivers and Streams Water Quality Assessment" section of this report. In addition to data collected through the Probabilistic Monitoring program, IDEM also uses data collected by the

agency's other water monitoring programs to make reach-specific assessments and may use data from external sources if they meet the necessary data quality requirements.

Comprehensive Use Support Assessments

Comprehensive assessments are statistical calculations that allow IDEM to predict with reasonable certainty the percentage of Indiana's rivers and streams within a given area that are either impaired or supporting their designated uses. Comprehensive use support assessments are based solely on the reach-specific assessment results from data collected by the Probabilistic Monitoring Program because, unlike data collected through other IDEM monitoring programs and most external organizations, these data are collected using a probability-based sampling design, which is necessary to make statistically valid calculations.

IDEM's comprehensive use support assessments and its reach-specific assessments of designated use support provide water quality information in two very different ways, and IDEM uses both types of assessments to meet CWA requirements. The agency's comprehensive assessments, which rely on probabilistic data, provide statistically valid statements about the overall water quality throughout Indiana on a basin level, which allows IDEM to meet the CWA requirement to assess all the waters of the state. These results are stated as the percentage of the total stream miles in each basin meeting their designated uses and the percentage that are impaired. These percentages are statistically derived and cannot be applied to specific streams or stream reaches. Given this, they do not identify where specific impairments exist, which is required by Section 303(d) of the CWA. Information regarding the location of impairments is provided by IDEM's reach-specific results, which are based on data collected from a variety of sources including IDEM's Probabilistic Monitoring Program.

This report provides comprehensive assessments for watersheds in all of Indiana's major basins (Appendix F) in addition to summaries of results from IDEM reach-specific assessments (Appendix A). This report also includes the 2018 finalized 303(d) List of Impaired Waters (Appendix I), which identifies waters impaired for one or more designated uses.

This report builds on the water quality assessment results reported in the 2016 Indiana Integrated Water Monitoring and Assessment Report and includes updated assessments for the Upper Wabash River Basin monitored in 2015, and the Lower Wabash River Basin monitored in 2016. This report also contains assessment information based on total maximum daily loads (TMDLs) developed in other basins throughout Indiana.

Water Quality Assessment Methodology

IDEM's CWA Section 305(b) water quality assessments are conducted in accordance with its CALM, which is provided in Appendix G. Water quality assessments are made for each designated use and waterbody type by comparing the available with the applicable WQS following the methods articulated in the CALM. Assessment results are then entered into IDEM's assessment data management system. For the 2018 cycle forward, this will be ATTAINS, which IDEM will use to compile its Consolidated List and 303(d) List of Impaired Waters.

Assessment Methods for the Ohio River

IDEM collaborates with the Ohio River Sanitation Commission (ORSANCO) to conduct water quality assessments of the Ohio River reaches that border Indiana. ORSANCO is an interstate water pollution control agency established for the Ohio River through a compact agreement between member states and approved by Congress. Under the terms of the compact, member states cooperate in the control of water pollution in the Ohio River Basin.

ORSANCO collects most of the data used to make water quality assessments and works with the compact states to determine the degree to which the Ohio River is meeting its designated uses. Based on the results of this collaborative assessment, ORSANCO produces a CWA Section 305(b) water quality assessment report for the Ohio River every two years. Member states then incorporate those results into their individual CWA 303(d) lists in accordance with their individual 303(d) listing methods. A more detailed discussion of Ohio River assessments can be found in IDEM's CALM (Appendix G).

Although the assessment methodology for the Ohio River differs somewhat from the methods IDEM uses to assess other Indiana rivers and streams, the assessment results for all rivers and streams in Indiana, including the Ohio River, are combined for the purposes of this report.

Assessment Methods for Public Water Supply

In 2016, IDEM developed new methods to for determining use support of waters serving as a source water for public water supply facilities. IDEM published these methods in the CALM with the draft 303(d) list for public comment during the 2016 integrated reporting cycle. .

These methods were finalized for the 2018 cycle with few revisions. To date, their implementation has been slowed by the lack of data available for assessment. IDEM knew when developing the methods that there was very little existing and readily available data to implement them but proceeded based on the expectation that previously unidentified data may become available through the EDF.

While IDEM currently lacks the resources to support a new monitoring program dedicated to monitoring source waters for public water supplies, the agency continues to explore strategies for increasing the amount of available data for source water assessments and is working with its Drinking Water Branch to identify ways to potentially partner with drinking water facilities to facilitate the collection of data that may be used for the assessment of their source water.

IDEM believes that its new public water supply assessment methods, coupled with more readily available data for assessments, will result in greater protection of Indiana's public water supplies going forward.

REPORTING WATER QUALITY ASSESSMENT RESULTS

Indiana's Consolidated List

For the purposes of Clean Water Act (CWA) 305(b) reporting, the Indiana Department of Environmental Management (IDEM) employs a multi-category approach in which every waterbody is placed into one of five categories (or subcategories) for each of the following designated uses: aquatic life use, recreational use, fish consumption⁴, and public water supply⁵.

The state's Consolidated List provides a full inventory of all Indiana waters IDEM tracks for the purposes of assessment including information regarding the degree to which they are supporting their designated uses.

A waterbody is assessed as fully supporting a designated or other use when it is found to be meeting the water quality standards (WQS) applicable to that use. When a waterbody is not meeting one or more of the applicable standards, it is considered impaired, meaning it is not fully supporting the use. Figure 7 in Appendix B illustrates the decision-making process IDEM uses to determine the appropriate category for each use for which a waterbody is designated. A more detailed explanation of the five categories and their subcategories is provided in IDEM's Consolidated Assessment and Listing Methodology (CALM) (Appendix G). The following provides a summary:

Category 1	The available data and/or information indicate that all designated uses are supported and no use is threatened.
Category 2	The available data and/or information indicate the individual designated use is supported.
Category 3	The available data and/or other information are insufficient data to determine if the individual designated use is supported.
Category 4	The available data and/or information indicate that the individual designated use is impaired or threatened but a total maximum daily load (TMDL) is not required.
Category 5	The available data and/or information indicate the individual designated use is impaired or threatened, and a TMDL is required.

IDEM will develop its 2018 Consolidated List (Categories 1-5) to U.S. EPA when Indiana's data in ATTAINS become available for reporting purposes and will provide that list to U.S. EPA as Appendix K of the 2018 Integrated Report. Indiana's 303(d) List of Impaired Waters

The 303(d) List of Impaired Waters is a subset of the Consolidated List and includes only Category 5 waters – those for which a TMDL is required. Unlike the Consolidated List, which is required under CWA Section 305(b), the CWA Section 303(d) List of Impaired Waters is subject to approval by the United States Environmental Protection Agency (U.S. EPA).

⁴ Fish consumption is not a designated use in Indiana's WQS. IDEM assesses Indiana waters for fish consumption pursuant to current U.S. EPA policy and in keeping with CWA goals, which are reflected in Indiana's WQS (327 IAC 2-1-1.5 and 2-1.5-3).

⁵ Applicable only to waters that serve as a routine or emergency source of water for a public water system.

On May 8, 2013, U.S. EPA partially approved Indiana's 2010 303(d) List of Impaired Waters. U.S. EPA's partial approval is based on concerns regarding IDEM's methods for evaluating metals data for the purposes of determining impairment. More detail about these concerns and IDEM's response to them can be found online at: www.in.gov/ide/nps/3889.htm.

The issues delaying full approval by U.S. EPA remain unresolved. In the meantime, IDEM has continued to conduct water quality assessments and remains committed to reporting the results of its assessments to the public in a timely manner.

To ensure that Indiana's 303(d) list contains the most up-to-date assessment information, each 303(d) list builds upon the list developed for the previous two-year reporting cycle. Therefore, to develop its 2012 303(d) List of Impaired Waters, IDEM used the approved portion of the 2010 303(d) list as a starting point. IDEM used the same approach to develop the 2014 and 2016 303(d) lists and now, the draft 2018 303(d) list, building each from the list submitted for the previous cycle.

For the development of the 2018 Draft 303(d) List of Impaired Waters, IDEM has followed, to the degree possible, the 305(b) and 303(d) reporting methods outlined in U.S. EPA "Guidance for 2004 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act" (U.S. EPA, 2003) and the additional guidance provided in U.S. EPA memorandums containing information concerning CWA Sections 303(d), 305(b), and 314 integrated reporting and listing decisions for the 2006, 2008, 2010, 2012, 2014, and 2016 cycles (U.S. EPA, 2005-2015). The draft 303(d) list for 2018 was prepared and published in the Indiana Register for a state-required 90-day public comment period beginning on April 11 and ending on July 10, 2018. No comments were received during this time. The narrative portion of the public notice is provided in Appendix J. All the materials for Indiana's finalized 2018 303(d) list, which is included in Appendix I of this report can be found on the Office of Water Quality Web site at: www.in.gov/ide/nps/2647.htm.

CLEAN WATER ACT SECTION 305(B) ASSESSMENTS

This report provides summary assessment results indicating designated use support for waters throughout Indiana based on waterbody type. Lakes and reservoirs are each assigned a single assessment unit ID (AUID) with sizes reported in acres. Due to its large size and unique characteristics as compared to other freshwater lakes in Indiana, Lake Michigan and its shoreline are each discussed in separate sections of this report. Results for Lake Michigan are reported in acres, and results for the shoreline are reported in miles. Assessment information for rivers and streams are likewise discussed in a separate section of this report with results given in miles.

Each section provides a table summarizing designated use support by individual use and total size in miles or acres. It is important to note that these values are not additive because a single waterbody is typically designated for at least three uses and sometimes four, and the waterbody can have one or more impairments for a single use. Adding the total values for each use would result in far more stream miles and lake acres than what actually exists in Indiana.

Summary results regarding the causes/stressors and sources of impairment are also provided for each water body type. As with the values in the summary tables for designated use support, the summary values in each table should not be added because doing so would artificially inflate the number of miles or acres actually impaired.

Causes of impairment identified in the summary tables are those pollutants or other stressors that contribute to the impairment of the designated uses of a waterbody. In some cases, only the symptom(s) of impairment can be identified. For example, the Indiana Department of Environmental Management (IDEM) may have evidence that biotic communities in a waterbody are impaired, but the data are insufficient to determine the actual pollutant or stressor causing the impairment. In these cases, the symptom – impaired biotic communities – is treated as the cause of impairment for the purposes of this report.

The sources shown in the summary tables are the activities that contribute the pollutant(s) or create other stressors that result in impairment of a designated use. For most assessments, the sources identified at the time of assessment for a given impairment are not precisely known, this is because IDEM's assessment processes, and most of the water quality monitoring the agency conducts, are designed to identify impairments, not specific sources. Accurately attributing a given impairment to specific sources is difficult at best without more detailed and resource intensive sampling and analyses and is often impossible to do with an acceptable degree of certainty. This kind of monitoring is typically conducted during total maximum daily load (TMDL) development, which requires the identification of sources in order to develop recommended loadings to support its restoration. The sources identified during the assessment process represent those determined by IDEM staff members to be the most likely sources given a variety of factors, which include but are not limited to:

- Land uses (as indicated by field observations and land use data from published sources such as the U.S. Geological Survey Gap Analysis Program, aerial photography, etc.).
- Field observations of potential sources such as illegal straight pipes, tillage to the stream's edge, livestock in the stream, etc.
- The presence of permitted facilities within close proximity of the impaired waterbody in cases where the impairment is something that could reasonably be expected to be associated with the discharge of those facilities.
- Naturally occurring conditions that could contribute to impairment.

IDEM believes that by using best professional judgment, scientists can distinguish the most likely sources of impairment in the watershed and provide a starting point for a TMDL, watershed planning or other activities aimed at restoring the waterbody.

Rivers and Streams Water Quality Assessment

Rivers and streams are assessed for support of aquatic life use, recreational uses, and fish consumption. Where there is sufficient data, rivers and streams that serve as a source water for a public water supply are also assessed to determine the degree to which they support that use.

The number of stream miles in Indiana that have been assessed to date, and the number of miles fully supporting and impaired are shown for each individual use in Table 10 (Appendix A).

Table 11 (Appendix A) represents the total miles of streams affected by each cause/stressor in Indiana. These tables include identified causes of impairment and symptom of other observed effects such as impaired biotic communities and low dissolved oxygen. For these and other observed effects, the substance(s) and/or stressors remain unknown. Table 12 (Appendix A) includes all the potential sources driving one or more of the impairments in Table 11, and the total stream miles impaired due to each. Potential sources include agricultural sources and those resulting from urban activities and land development. Illicit connections identify "straight pipes" from buildings in unsewered areas that flow into

state waters with little or no treatment. Contaminated sediments are largely due to polychlorinated biphenyls (PCBs) that correlate with elevated PCB levels in fish tissue.

Great Lakes Shoreline Water Quality Assessment

Indiana's entire portion of the Lake Michigan shoreline was last assessed in 2001 and was found to be fully supporting of aquatic life use and fully supporting of its use as a public water supply for the 35 miles so designated. All 67 miles of the shoreline in Indiana were assessed as impaired for recreational use and fish consumption. The required total maximum daily loads for the shoreline's recreational uses were approved by United State Environmental Protection Agency (U.S. EPA) in 2004:

www.in.gov/idem/nps/2856.htm. As a result, the *E. coli* impairments for which the shoreline has been assessed now appear in Category 4 of Indiana's Consolidated List while the fish consumption impairments for PCBs and mercury in fish tissue remain in Category 5 (Indiana's 303(d) list).

IDEM's assessment results are summarized in Table 13 (Appendix A). The specific causes of impairment to Indiana's Lake Michigan shoreline are reported in Table 14 (Appendix A), and the potential sources are summarized in Table 15 (Appendix A).

Lake Michigan Water Quality Assessment

Because Lake Michigan is assessed as a single unit, any impairment identified in any part of the lake is applied to all 154,176 acres of Lake Michigan within Indiana's borders. Assessments of Indiana waters of Lake Michigan indicate impairment for mercury and PCBs in fish tissue. Tables 16-18 (Appendix A) reflect the results of these assessments.

Water Quality Assessments of Other Lakes

IDEM conducts two types of assessments on Indiana Lakes, which include natural lake and reservoirs. Clean Water Act (CWA) Section 314 requires states to report on the trophic status and trends of all publicly owned lakes in Indiana, and CWA Section 305(b) requires states to report on the degree to which Indiana's lakes and reservoirs are supporting their designated uses. Both types of assessments and the methods with which they are conducted are described in IDEM's Consolidated Assessment and Listing Methodology (CALM) (Appendix G).

IDEM evaluates lakes primarily for recreational uses and fish consumption for the purposes of CWA Section 305(b) assessments. While IDEM monitors several lakes for fish consumption, other types of monitoring for determining designated use support assessments of Indiana lakes is limited. As a result, IDEM's assessments have relied primarily on external data collected through the Indiana Clean Lakes Program (CLP) for the purposes of CWA Section 314 assessments.

The monitoring conducted by the Indiana CLP provides results for all the parameters necessary to calculate Carlson's Trophic State Index (TSI)⁶ scores, which allows IDEM to make both CWA Section 314 trophic state assessments and some CWA Section 305(b) assessments for recreational use. However, neither the individual parameter results nor the TSI scores are considered sufficient for determining the condition of biological communities for the purposes of determining aquatic life use support.

⁶ See Carlson, 1977.

Use support assessments of lakes for public water supply are also limited but for different reasons. Compared to other designated uses, which apply to all waters of the state, these assessments are made only to the relatively few lakes and reservoirs in Indiana that are used directly or indirectly as source water for public water supplies.

IDEM's assessment methods for CWA Section 305(b) assessments of lakes and reservoirs are described in more detail in its CALM (Appendix G). Summary assessment results for the 2018 cycle are provided in Tables 19-21 (Appendix A).

CWA SECTION 314 ASSESSMENTS

Section 314 of the federal Clean Water Act (CWA) requires states to report on the trophic status and trends of all publicly owned lakes in Indiana. To determine the trophic state for a given lake (the amount of biomass present at the time the measurement is taken), the Indiana Department of Environmental Management (IDEM) uses Carlson's TSI, which can be calculated for three variables -- Secchi depth, total phosphorus (TP), and Chlorophyll-*a* (CHL). Each of these variables can be used as independent indicators of the trophic state of the lake or reservoir in question and together to help understand the potential drivers of trophic condition. . Although any of the three could be used to determine trophic state, IDEM uses the TSI for CHL to make its trophic state assessments because CHL concentrations provide a more direct measure of phytoplankton abundance than Secchi depth or TP. Lakes are classified based on their trophic condition as indicated by TSI (CHL) scores. Higher scores are an indicator of nutrient enrichment, which can come from both natural sources and sources related to human activities. Details on how the TSI (CHL) scores are calculated can be found in IDEM's Consolidated Assessment and Listing Methodology (CALM) (Appendix G).

For the purposes of this report, Indiana lakes were placed in one of four classes based on their trophic state. These classes are shown in Table 22 (Appendix A). A summary of the trophic status information for lakes assessed to date is presented in Table 23 (Appendix A). Lake trends, which are determined based on changes in the trophic state over time are summarized in Table 24 (Appendix A). Approximately 19 percent of the lakes assessed to date (20 percent of the acres assessed) show some water quality improvement as measured by a reduction in their trophic scores. Forty-one percent of the lakes assessed (23 percent of the acres assessed) appear to have relatively stable trophic conditions. Thirty-six percent of the lakes assessed to date (53 percent of the acres assessed) show an increase in their trophic scores indicating that the trophic conditions are degrading.

The water quality trend appears to be fluctuating for four percent of the lakes (four percent of the acres assessed). For these lakes, the lack of detectable trend may be due to abnormal seasonal effects or changing activities in the surrounding watershed. In cases where the available data are insufficient to determine a trend, the trend is reported as unknown. Waterbody-specific results for trend and trophic status and trends for Indiana's lakes and reservoirs statewide are provided in Appendix L.

PUBLIC HEALTH/AQUATIC LIFE CONCERNS

Toxic substances can be found in surface waters across the country including toxins in substances that are currently in use as well as substances now banned (commonly referred to as legacy contaminants). Some toxins are produced naturally. Regardless of the source, the release of toxic materials into the aquatic environment can threaten public health by contaminating drinking water supplies, fish and shellfish, and recreational waters. Their impacts can include:

- Contaminants present in acutely toxic amounts may kill fish or other aquatic organisms directly.
- Substances present in lesser, chronically toxic amounts can reduce densities and growth rates of aquatic organisms and/or become concentrated in their body tissues.
- These substances can be further passed to humans through consumption of the organism. The toxins can then accumulate in our bodies and cause diseases.
- Toxic materials in the water could potentially affect human health by contaminating public water supplies.

Fish Consumption

In the last several years, advances in analytical capabilities and techniques and the generation of more frequent and higher quality toxicity information on chemicals have led to an increased concern about their presence in the aquatic environment and the associated effects on human health and other organisms. Many pollutants are likely to be found in fish tissue and bottom sediments at levels higher than in the water column. Much of the data on toxic substances used for fishable use assessments in this report were obtained through the Indiana Department of Environmental Management's (IDEM's) Fish Tissue Contamination and Sediment Contaminants Monitoring Programs in the Office of Water Quality (OWQ).

Contaminants of emerging concern are increasingly being detected at low levels in surface water around the country and there is concern that these compounds may have an impact on aquatic life. Emerging contaminants are important because the risk they pose to human health and the environment is not yet fully understood. The United State Environmental Protection Agency (U.S. EPA) has identified perfluorinated chemicals (PFCs) as a group of contaminants of emerging concern. Their resistance to degradation causes PFCs to be detected at low concentrations throughout the environment. In 2017, IDEM began analyzing fish tissue samples for 13 different perfluorinated compounds in order to characterize their concentrations across the state. Monitoring for these compounds will continue on an annual basis until background levels are established, potential sources are determined, and the threat to human health and the environment is better understood.

In 2016, the U.S. EPA published the final national chronic aquatic life criterion for selenium in fresh water. The criterion reflects the latest scientific knowledge, which indicates that selenium's toxicity to aquatic life is primarily based on organisms consuming selenium-contaminated food rather than by being exposed to selenium dissolved in water (U.S. EPA 2016). Two components of the criterion are based on the concentration of selenium in fish tissue (eggs and ovaries, and whole-body or muscle) and two components are based on the concentration of selenium in the water-column (two 30-day chronic values and an intermittent value). IDEM has been collecting selenium in fish tissues since 2007 and currently has a dataset consisting of more than 1,600 records. Using data through 2015, the three preparations of interest, whole fish, skin-on fillets and skin-off fillets, selenium concentrations exceeded the most appropriate selenium criteria in 5.4 percent, 0.9 percent, and 0.0 percent of the samples respectively. IDEM has found that, generally, levels of selenium in Indiana wild and sport fish are not of concern in relation to the newly finalized 2016 U.S. EPA water quality criteria for selenium, however some isolated waterbodies do exist.

Figure 8 (Appendix B) shows the breakout, by species, of all whole fish samples having a selenium result. The criteria for whole fish – 8,500 micrograms per kilogram dry weight (ug/kg dry wt.) which is equivalent to a concentration of 8,500 parts per billion (ppb) – is superimposed on the graph as a benchmark. Figure 9 (Appendix B) shows a breakout, by species, of all filleted (including-skin on and skin-off fillets) fish samples having a selenium result. The criterion for fillets (fish muscle skinless and boneless) is 11,300 µg/kg dry wt., or 11,300 ppb. This benchmark is superimposed on the graph.

IDEM actively participates in the development of the Indiana Fish Consumption Advisory (FCA) by conducting the monitoring necessary for its development and actively participating in the Indiana Interagency FCA Work Group, whose mission is to:

- Maintain the health benefit of fish consumption.
- Minimize the potential for consumer toxic chemical exposure.
- Use credible and understandable science.
- Present information in a manner conducive to maximal voluntary compliance.

With this mission in mind, the work group has spent several years updating rules that guide the development of consumption advisories. In 2017, the work group completed a statewide reassessment of rivers and streams, lakes and reservoirs to update the Indiana FCA. While not all species of fish found in Indiana lakes and streams have been tested, IDEM's Contaminants Monitoring Program continues to target the fish found in Indiana's major river systems, known contaminated areas, waterbodies on public properties, major reservoirs and natural lakes, waterbodies requested by other agencies or program areas, and the core stations that have been sampled since 1979. The Indiana FCA, information on the benefits of eating fish, recipes, information on contaminants, taxonomy guides, and the Statewide Safe Eating Guide can be found on the Indiana State Department of Health (ISDH) website at: www.in.gov/isdh/23650.htm.

Fish consumption assessments are reported separately from aquatic life use in order to provide more information about each individual use. Concerns related to fish consumption should be evaluated independently by referring to the fish consumption advisories. While the 303(d) List of Impaired Waters is not designed to provide public health information, the fish consumption advisory is designed specifically for that purpose and is far more reliable for use in deciding the amount of fish that might safely be consumed from a given waterbody.

Cyanobacteria and Algal Toxins

Blue-green algae (cyanobacteria) continue to be a concern in Indiana lakes and reservoirs both with respect to recreational uses and public water supply for drinking water. Blue-green algae are natural and common constituents of algal communities in lakes. However, many are known to produce potent toxins, known as "cyanotoxins", which are now recognized as a potentially serious threat to human and animal health.

Microcystin is the cyanotoxin most commonly monitored. In 2010, IDEM piloted a targeted monitoring effort to support the development of an interagency process for the development of public health advisories for blue green algae and algal toxins. Monitoring was conducted statewide at 14 swimming areas owned or managed by the Indiana Department of Natural Resources (IDNR) on a monthly basis from May through August. Sampling frequency was increased to biweekly for lakes where cyanobacteria densities are found to be greater than 100,000 cells per milliliter, as recommended by the World Health Organization.

The public is kept informed of the status of the sampled swimming areas by the www.algae.IN.gov website and the IDNR site for the specific property. IDEM's website also incorporates public health information related to blue-green algae from the ISDH and the Board of Animal Health as well as other relevant information from government agencies and educational institutions. When the two-year grant period for the pilot project ended, IDEM incorporated a blue-green algae monitoring program into its overall water monitoring strategy. Monitoring is now routinely conducted at 15 state-owned sites and samples are analyzed for Microcystin, Cylindrospermopsin, Anatoxin-a, and Saxitoxin throughout the recreational season each year (April 1, through October 31).

In 2010, IDEM also contracted with Indiana University's School of Public and Environmental Affairs (IU-SPEA) to conduct a different, but related, pilot project to monitor Microcystin at all of the same lakes to be monitored for the Indiana Clean Lakes Program (CLP). Like the Microcystin monitoring conducted by IDEM, it is anticipated that the results from this monitoring will help IDEM to better understand the environmental variables associated with blue-green algal blooms and Microcystin production. However, results from the CLP Microcystin monitoring are not used to support the development of public health advisories because they are collected for a different purpose and use different methods than those used by IDEM to conduct its sampling.

IDEM does not use information collected through these monitoring programs to make 305(b) assessments because the environmental factors that influence the occurrence and production of algal toxins are not well understood, and there are no federal drinking water standards for blue-green algae. U.S. EPA's Office of Water has listed cyanobacteria and cyanotoxins on its drinking water contaminant candidate list (CCL) for the first time in 1998. And, in 2009, U.S. EPA specifically included Anatoxin-a, Cylindrospermopsin, and Microcystin-LR, on [CCL 3](#) and again on [CCL 4](#) in 2016. CCLs are used to prioritize federal research and data collection efforts to help determine whether a specific contaminant needs to be regulated. More information on U.S. EPA's CCL is available online at: www.epa.gov/ccl.

In 2015, U.S. EPA developed Health Advisories for Cylindrospermopsin and Microcystin. It is anticipated that as more scientific information becomes available, including the development of a federal water quality criteria for algal toxins, it may be possible to develop water quality assessment methods that will allow IDEM to determine the impact that algal toxins may be having on the designated uses of Indiana waters.

Fish Kills and Chemical or Other Spills

A diverse and healthy fish community is considered an indication of good water quality. Serious public concern is generated when dead and dying fish are noted in the aquatic environment because fish kills are sometimes evidence of a severe water quality problem. Fish kills also have the potential to impair the use of the waterbody in the short or long term. A fish kill can occur as a result of:

- An accidental or intentional spill of a toxic compound or oxygen-depleting substance into the aquatic environment.
- A continuous industrial or municipal discharge due to a system upset which can result in releases of atypical or unusually high concentrations of pollutants.
- Natural causes such as disease, extreme draught or depletion of dissolved oxygen from extreme weather conditions.

IDEM's Office of Land Quality tracks spills and fish kills reported to IDEM or discovered by agency staff members. The total number of calls, spills, and kills recorded from 1998 to 2018 are listed in Table 25 (Appendix A).

GROUND WATER ASSESSMENT

In order to be eligible for Clean Water Act (CWA) Section 106 grant funds, Indiana is required to have the means to monitor water quality (and to annually update water quality data and include the results in their biennial IR to U.S. Environmental Protection Agency (EPA). While U.S. EPA's integrated reporting requirement pertains primarily to surface waters, U.S. EPA guidance suggests that state updates should also include ground waters to the extent practicable. This section provides a summary of Indiana's ground water monitoring and protection programs, ground water/surface water interactions within Indiana, ground water quality, and ground water contamination sources.

Ground water is an important resource for Indiana citizens, agriculture and industry. The majority of Indiana's population relies on ground water for drinking water and other household uses. The Indiana Department of Environmental Management's (IDEM's) 2016 Annual Compliance Report for Indiana public water supply systems is online at:

www.in.gov/idem/cleanwater/files/dw_compliance_report_2016.pdf.

MAJOR SOURCES OF GROUND WATER CONTAMINATION

The major contaminant sources impacting Indiana ground water are listed by general activity types in Table 26 (Appendix A). All sources listed are a potential threat to ground water. The degree to which the source is a threat to ground water depends on several factors with the most significant being hydrogeologic sensitivity. Other major risk factors include location of the contaminant source relative to drinking water sources, the toxicity of the contaminant, and the size of the population at risk. All risk factors listed in Table 26 were considered in the selection of ten priority contaminant sources, and those risk factors relevant to the highest priorities are identified. Classes of contaminants commonly associated with each high priority contaminant source are also given. Due to resource constraints, this information has not been significantly updated since the 2000 305(b) report. However, anecdotal evidence indicates the same major contaminant sources are impacting Indiana ground water now as they were at that time. Fertilizers

Nitrate is a potential contaminant that can be introduced into the environment from a variety of sources, including commercial fertilizer and animal manure applications to farm land, and septic systems – all of which are considered high priority sources of potential contamination to Indiana ground water. Nitrate is a highly mobile and soluble contaminant and is most frequently detected in ground water in rural areas. However, determining the source of nitrates detected in ground water can be difficult and costly.

When applied at the proper rate and time, commercial fertilizer poses little threat of contamination to ground water. Purdue University Cooperative Extension Service staff members, Natural Resource Conservation Service staff members, and private consultants assist crop producers in developing nutrient management plans that focus on meeting the nutrient needs of their crops using only the amount of fertilizer necessary.

On July 28, 2010, the state rule requiring certification for distributors and users of fertilizer materials (355 IAC 7-1-1) became effective and is administered through the Office of the Indiana State Chemist

(OISC). The rule was supported by a variety of agricultural groups and other stakeholders who envisioned the rulemaking as an opportunity for fertilizer material applicators and distributors to demonstrate their competency to handle and apply these materials safely and effectively. In addition, this provides a statewide standard for applicator certification and training.

For purposes of the rule, “fertilizer material” is defined to mean both commercial fertilizer and manure from a confined feeding operation (CFO). Any person hired to apply, handle, or transport fertilizer material for purposes of producing an agricultural crop must be certified and licensed by OISC. Alternatively, he or she must be trained and supervised by a certified applicator, and be working for a licensed fertilizer business. Any person applying manure from a CFO (in excess of 10 cubic yards or 4,000 gallons per year) to his/her own property must be certified by OISC as a private fertilizer applicator. Any person, partnership, corporation, or business that distributes but does not use fertilizer material must obtain a fertilizer distributor business license.

Confined Feeding Operations

Livestock and poultry confined feeding operations (CFOs) exist throughout Indiana and are an integral component of Indiana’s agricultural economy. The primary concerns associated with CFOs are the proper storage and land application of the large volumes of manure produced by these operations. The manure is applied to farmland to recycle the nutrients to fertilize crops. Manure contains ammonia-nitrogen which is converted to nitrate through biological processes in the soil. Consequently, the rate of manure application to farmland is a major concern when the application provides more nitrogen than a crop will use. Because excess nitrogen can move beyond the crop root zone and potentially into underlying aquifers, Indiana’s current regulations for CFOs require the proper design and construction of manure storage structures and the application of manure to land in a manner that protects ground and surface water quality. Crop nutrients contained in manure are available at a slower rate than commercial fertilizer nutrients due to the rate of decomposition of the manure. Therefore, when applied at the proper agronomic rate, manure poses little threat of contamination to ground water.

Septic Systems

Properly constructed and maintained septic systems provide satisfactory on-site treatment of domestic wastewater in rural and unsewered suburban areas of Indiana. However, improperly constructed or poorly maintained septic systems, as well as systems operating in areas of high seasonal water tables or other ground water sensitive areas, are also of concern as a source of nitrate contamination to ground water.

Landfills and Underground Storage Tanks

Landfills and underground storage tanks are a high priority concern for ground water due to practices or activities that occurred prior to construction standards and legislation established for its protection. Landfills constructed after 1988 have been required to adhere to stringent construction standards. Since then, underground storage tank registration, upgrading, closure activity and site assessment have been closely reviewed by the IDEM Underground Storage Tank (UST) Section.

IDEM has ensured that all regulated UST owners and operators properly registered, upgraded and/or closed existing UST systems in accordance with state requirements. Currently, IDEM inspects all USTs systems at least once every three years to ensure that systems are properly designed and operated for corrosion protection, spill and overflow protection, and leak detection in order to prevent releases or ensure

early detection of any releases. UST systems that are no longer in use are inspected to ensure they are properly closed. In addition, IDEM ensures that all confirmed releases of petroleum and hazardous substances into the environment, including groundwater, are cleaned up as necessary to protect human health.

Underground Injection Wells

Class V underground injection wells are widespread throughout the state and occur in high concentration in several areas, including some areas where ground water is highly sensitive to contamination. Most Class V wells are shallow wells that are used by business and individuals to dispose of a wide variety of non-hazardous fluids into the ground. These wells are regulated by the United States Environmental Protection Agency (U.S. EPA) and can release a wide variety of waste fluids into the ground. Under current regulation, Class V wells may be used to dispose of non-hazardous fluids only. However, this was not always the case.

Prior to 2000 when the U.S. EPA passed more intensive regulations and enforcement for Class V wells, they were sometimes used to dispose of potentially hazardous fluids. These older wells create the potential for groundwater contamination if the fluids they contain are hazardous and leach into or above aquifer supplying drinking water. These wells are regulated directly through the U.S. EPA Class V Underground Injection Control Program, which targets the wells that pose the greatest environmental risk.

Industrial Activities

Several cases of ground water contamination due to industrial facilities or their ancillary operations have been documented in Indiana. Although many contamination events occurred prior to the development of regulations for the storage and handling of industrial materials, ground water contamination still occurs as a result of either accidents or intentional dumping of waste. In 1998, Indiana's Secondary Containment of Above-Ground Storage Tanks Containing Hazardous Materials Rule (327 Indiana Administrative Code (IAC) 2-10) was adopted. This rule requires that new facilities provide secondary containment for storage of 660 gallons or more of hazardous wastes if the facility is located outside an approved delineated wellhead protection area. However, if the facility is located within a wellhead protection area, secondary containment is required for any tank storing 275 gallons or more of hazardous materials.

The secondary containment rule along with IDEM's outreach and education programs have helped to prevent further ground water contamination from the storage and handling of industrial materials. However, these activities continue to be a potential source of contamination to ground water in Indiana.

Road Salts

The storage and extensive use of salt as a deicing agent during the winter months has an impact on ground water, and contamination from road salt has been documented in Indiana. Efforts are being made by the Indiana Department of Transportation (INDOT) to build any new salt storage facilities only in areas where ground water is not sensitive to contamination and to upgrade existing facilities to protect ground water. Currently all INDOT salt storage facilities are covered by domes or canopies, and several new facilities have been built to contain all surface runoff on-site to reduce ground water contamination. In addition, road salt use and application rates have been significantly reduced from past years through computerized weather forecasting and roadway temperature sensors.

Spills

Ground water contamination as a result of spills can be avoided or minimized if spills are reported to IDEM's Spill Line, which helps to ensure that they are handled and cleaned up properly. Indiana has a law in place to ensure that spills with the potential to contaminate ground water are reported and managed in a way that minimizes their impact (327 IAC 2-6.1).

GROUND WATER PROTECTION PROGRAMS

Programs that conduct monitoring to evaluate and protect ground water resources in Indiana occur at all levels of government. At the state level, several ground water protection programs and activities have been implemented or are in the process of being implemented. Table 27 (Appendix A) lists key ground water protection programs and activities in Indiana, developmental stage of the program or activity, and the agency or agencies responsible for the program's implementation and/or enforcement.

Classification of Indiana's Ground Water Resources

Indiana's ground water quality standards became effective in March 2002. The language of the rule includes numeric standards that provides ground water protection to wells and allows for the classification of ground water. The rule states that all ground water of the state shall be classified as drinking water class ground water unless it is classified as limited class ground water or impaired drinking water class ground water. The Indiana Department of Environmental Management (IDEM) may classify ground water as limited when ground water is shown to have a yield of less than 200 gallons per day or a total dissolved solids concentration of more than 10,000 parts per million (ppm). Additionally, ground water that is in the crop root zone, in a coal mined area, or in an injection zone of a permitted Class I, II or III injection well or gas storage well may be considered limited. IDEM may classify ground water as impaired when specific conditions are met. These conditions include, but are not limited to:

- The ground water is not in a state approved wellhead protection area established pursuant to 327 Indiana Administrative Code (IAC) 8-4.1.
- The ground water has one or more contaminant concentrations above the numeric criteria established in the rule.
- The commissioner has approved a ground water remediation, closure, cleanup or corrective action plan that describes the nature and extent of contaminants exceeding the criteria.

Source Water Assessment Program

In 2000, U.S. EPA approved Indiana's Source Water Assessment Program, which was developed by Indiana stakeholders. IDEM has prepared source water protection plans (SWAPs) for all public water systems with the exception of community water systems that instead use ground water as their primary source of water. These systems are instead required by the Indiana Wellhead Protection Rule (327 IAC 8.4.1) to prepare a wellhead protection plan for each well or well field that provides water to the public. Since 2000, source water areas for more than 3,600 public water systems have been delineated. IDEM has also inventoried the potential sources of contamination of these source water areas and has assessed water system susceptibility to contamination. By the end of 2008, IDEM had distributed all SWAPs for Indiana's public water systems to their owners. As a result of this effort, IDEM's Source Water Assessment Program is completely implemented and satisfies the requirements of the Source Water Assessment Program as defined by IDEM and accepted by U.S. EPA.

The Indiana Wellhead Protection Rule (327 IAC 8-4.1) became effective in March 1997, which is implemented by IDEM's Wellhead Protection Program (part of IDEM's Source Water Assessment Program) to protect public water supplies from contamination. The Wellhead Protection Rule outlines the minimum requirements community public water supplies must meet to comply with the Indiana Wellhead Protection Rule. . As of October 2009, 633 (close to 98 percent) of Indiana's community water systems using ground water as their source of drinking water have an approved wellhead protection plan. Having an approved wellhead protection plan indicates that a community has met the requirements of the Indiana Wellhead Protection Rule and has developed strategies to adequately protect their community water supplies from becoming contaminated.

Other Programs Working to Protect Indiana's Ground Water Resources

In addition to regulatory programs and other structured ground water protection activities listed in Table 27, there are several educational programs conducted in Indiana that place an emphasis on ground water protection. The Purdue University Extension Service's Safe Water for the Future Program serves as an umbrella program for several other programs that provide resources on drinking water protection for individuals and communities. The Farm*A*Syst and Home*A*Syst Programs are essentially wellhead protection programs for rural and domestic private wells. A series of publications and brochures on wellhead protection are also available to assist communities working on wellhead protection. "Watershed Connections" brings together local contacts to produce a community specific publication on water resources and their protection.

The Indiana Department of Natural Resources' Project WET (Water Education for Teachers) and Purdue University Extension Service's "Water Riches" Program are two general water education programs that provide information about ground water protection.

GROUND WATER MONITORING FOR PUBLIC WATER SUPPLIES

The Compliance Section of the Drinking Water Branch at the Indiana Department of Environmental Management (IDEM) receives ground water compliance monitoring results reported by public water systems for volatile organic compounds (VOCs), synthetic organic compounds (SOCs), inorganic compounds (IOCs), nitrates (NO₃), and radionuclides.

Radionuclide monitoring consists of analysis for gross alpha particle activity. Public water supply systems collect samples from various points within their system including after water is treated and before it enters the distribution system. Samples can be collected from a single well or blended from two or more wells. Other parameters monitored by public water systems depend on the type of system. There are three types of public water systems: community, non-transient non-community, and transient non-community. The three types of public water systems are defined below:

- A community system is defined as a system that serves water to the public and has at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents. Examples of community water systems are municipal systems, mobile home parks, nursing homes and homeowners associations. Along with regular bacteria sampling, community systems are required to test for thirty regulated SOCs, 21 VOCs, 12 regulated IOCs, sodium, and radionuclides. Sampling for these parameters is required a minimum of once every three years depending on the levels of contaminants detected. As of March 2018, there are 781 community systems in Indiana.
- A non-transient non-community water system is defined as a public water system that is not a community water system which regularly serves the same 25 or more persons at least six months per

year. Examples of non-transient non-community water systems could include restaurants, factories, daycares and schools. Along with regular bacteria sampling, non-community non-transient systems are required to test for 30 regulated SOCs, 21 VOCs, 11 regulated IOCs (except sodium and fluoride), and radionuclides. Sampling for these parameters is required a minimum of once every three years depending on levels of contaminants detected. As of March 2018, there are 585 non-transient non-community systems in Indiana.

- A transient non-community is defined as a non-community water system that does not serve at least the same 25 people over six months per year. Examples of transient non-community water systems include restaurants, rest stops and gas stations. Along with regular bacteria sampling, transient non-community systems are required to test for radionuclides. As of March 2018, there are 2,672 transient non-community systems in Indiana.

Compliance monitoring results reported by public water systems are considered “treated water” and may not represent “source” or “raw water” results. Information reported to IDEM from public water systems may be viewed through the Safe Drinking Water Information System at: www.myweb.in.gov/IDEM/DWW/.

Statewide Ground Water Monitoring Network

The Ground Water Section of the Drinking Water Branch manages a statewide ground water monitoring network (GWMN). The GWMN seeks to establish a statistically-based model of ambient ground water quality across the state to determine how source water and drinking water supplies can be best protected and to evaluate ground water/surface water interactions. The GWMN employs the following strategy to meet these goals:

1. Collect ground water samples from public water supply (PWS) wells and private residential wells within distinct hydrogeologic areas of the state with the overall goal to determine the quality of ground water in the state’s aquifers.
2. Identify and expand sampling in areas with notable contamination.
3. Practice continual improvement adjusting the GWMN as necessary to fit resource needs (monetary/field support) and gaps in the data.

Sampling for the GWMN has been conducted annually since it was established in 2006. Although many of the sampling sites were revisited during multiple sampling rounds, the number of sites sampled each year varies based on site suitability, participant interest, availability of resources, and previous sampling results.

Beginning in 2013, the design of the GWMN was adjusted to provide more statistical power to the dataset by randomly selecting sites that were proportionally distributed across the state based on hydrogeologic settings. The Indiana Geological and Water Survey (IGWS) has divided the state into hydrogeologic settings to “provide a conceptual model to help interpret the occurrence, movement, and sensitivity to contamination of ground water in relation to ... the surface and subsurface environment” (Fleming, 1995). The IGWS has identified more than 240 individual hydrogeologic settings across the state. For the purposes of developing the GWMN, IDEM scientists grouped these into 20 generalized settings that are common throughout Indiana.

Based on the 20 generalized hydrogeologic settings, IDEM determined that approximately 398 samples are needed to accurately represent ambient ground water quality across the state for each

sampling round in the GWMN. These sampling sites were proportionally distributed throughout the 20 generalized hydrogeologic settings using a weighting procedure (known as stratified sampling) based on the percentage of located wells in that setting. The weighted number of samples in the generalized settings ranged from 1 to 154 samples. Three rounds of statistically-based sampling (using unique sites in each sampling round) were conducted from May 2013 to November 2016. The locations of the wells sampled during the statistically-based rounds is shown in Figure 10.

As a part of its implementation of the GWMN, IDEM Ground Water Section staff members:

- Randomly selected sampling sites in each general hydrogeologic setting from a pool of residential well owners that volunteered to participate in the GWMN.
- Collected ground water samples from drinking water wells for analysis at IDEM's contract laboratories.
- Reviewed analytical sampling results.
- Distributed sampling results to GWMN participants.
- Developed a program report.

IDEM's Ground Water Section collected most samples from May to September. Samples were generally collected from outdoor spigots that have not been treated or from source water sample taps in the case of public water supplies. Samples are analyzed for more than 200 parameters; including alkalinity, anions/cations, metals, nitrogen as nitrate-nitrite (N+N), synthetic organic compounds, volatile organic compounds, and pesticide degradates.

Table 28 shows summary statistics for the analytical parameters that were detected in the ground water samples collected during the three statistically-based sampling rounds. Disinfection byproducts and plasticizers were not included in this analysis. If a particular analyte was not detected, it was not included in the table. Applicable Maximum Contaminant Levels (MCLs) Secondary Maximum Contaminant Levels (SMCLs), or Recommended Levels are provided where applicable.

For all samples collected during this study, analytes that had the most occurrences above a MCL included arsenic and nitrogen as nitrate-nitrite (hereafter referred to as simply "nitrogen"). Parameters for which there were occurrences above the SMCL or U.S. Environmental Protection Agency (U.S. EPA) Recommended Levels included iron, manganese, sodium, sulfate, and strontium. VOC contamination was detected in several samples, including petroleum contamination (found in seven wells) and chlorinated solvents (found in three wells). Table 29 shows the VOC contamination detected in the GWMN samples.

Summary Results for Nitrogen as Nitrate-Nitrite

During GWMN sampling, 330 samples (about 28 percent) contained detectable levels of Nitrogen. Nineteen of those samples exceeded the MCL of 10 milligrams per liter, and the highest reported concentration was 22 milligrams per liter (mg/L). The locations of the sites sampled for nitrogen are displayed on an aquifer sensitivity map developed by Letsinger (2015) (Figure 11). In highly sensitive areas, ground water can be rapidly recharged by surficial infiltration, allowing potential contaminants (including nitrates and pesticides) found at the ground surface or shallow subsurface to be transported into the aquifer. Summary statistics were calculated for the nitrogen data for Indiana's generalized hydrogeologic settings (Table 30).

Average nitrogen concentrations for each hydrogeologic setting were also calculated for well type and depth, aquifer conditions, and aquifer sensitivity (Table 31). Higher nitrogen concentrations were generally found in shallow wells screened in unconsolidated material. Aquifers with “High” or “Very High” sensitivities also contained the highest average nitrogen concentrations. Oxidizing aquifers had significantly greater nitrogen levels and higher average concentrations than reducing aquifers. Previous studies (Freeze & Cherry, 1979) have shown that the distribution and mobility of nitrogen within aquifers can be influenced by groundwater redox conditions.

Summary Results for Arsenic

Arsenic is a naturally occurring element found primarily in rocks, soil, water, and plants in many areas of the United States, including Indiana. Natural events, such as infiltration of water, dissolution of minerals from clay, and erosion of rocks can release arsenic into water. Arsenic can also be released into the environment as a byproduct of industrial activities, such as wood preservation, mining, and smelting (IDEM, 2015).

In the most recent round of sampling, 517 samples (around 44 percent) contained detectable levels of arsenic. One hundred twenty seven of those samples (11 percent) contained arsenic concentrations above the MCL (10 micrograms per liter (ug/L)). The highest reported concentration was 130 ug/L. Figure 12 shows the location of the arsenic samples by hydrogeologic setting. Table 32 shows summary statistics for arsenic samples by hydrogeologic setting, and Table 33 provides a comparison between settings.

Around 48 percent of samples from unconsolidated wells contained detectable levels of arsenic, compared to 36 percent of samples from bedrock wells. Approximately 13 percent of unconsolidated wells contained arsenic above the MCL, compared to 7 percent of bedrock samples. Unconsolidated wells had a higher average Arsenic concentration (4.77 µg/L) than bedrock wells (3.2 µg/L). Wells screened in the 50- to 100-foot and the 100- to 150-foot depths had the highest average concentrations of Arsenic and the highest percentage of samples exceeding the MCL.

Reducing aquifers (as determined by negative values for oxidation reduction potential) had higher average Arsenic concentration (5.31 µg/L) than oxidizing aquifers (1.60 µg/L). Of the 127 samples, 123 exceeded the MCL for Arsenic were from reducing aquifers. Previous studies of glacial aquifers in the northern US (including Indiana) have shown that Arsenic concentrations are higher in aquifers under reducing conditions (Thomas, 2007).

Summary Results for Pesticides and Pesticide Degradates

Several pesticides were found in their parent form during sampling for the GWMN. Detected pesticides include Alachlor (one sample at 0.3 ug/L), Atrazine (four samples, 0.1 ug/L max), Endrin (one sample at 0.02 ug/L), Lindane (two samples, 0.03 ug/L max), and Simazine (two samples, 0.15 ug/L max). None of these detections exceeded or approached the MCL for that compound.

GWMN samples were also analyzed for breakdown products for several common agricultural herbicides. Many of the herbicides used in Indiana to control broadleaf and grassy weeds in corn and soybeans can produce one/more of the following substances as they break down in the environment into Ethanesulfonic Acids (ESA) or Oxanilic Acids (OA):

- Acetochlor ESA.
- Acetochlor OA.
- Alachlor ESA.
- Alachlor OA.
- Metolachlor ESA.
- Metolachlor OA.

These breakdown products – ESAs and OAs – are generally more water soluble and mobile than the parent herbicide. As a result, there is greater potential for these degradates to be found in ground water or surface water (Shoemaker, 2003). To date, there are no established MCLs or health recommendation for these pesticide degradates.

Detectable levels of these degradates were found in 205 of the GWMN samples (17.6 percent), with a highest reported concentration of 7.8 µg/L of Metolachlor ESA. Figures 13, 14, and 15 show the GWMN pesticide degradate results for Acetochlor ESA and OA, Alachlor ESA and OA, and Metolachlor ESA OA, respectively. Of the 205 samples that contained detectable levels of pesticide degradates, 91 (43 percent) contained more than one type of degradate compound, and 98 of the samples (48 percent) were located in areas of high or very high hydrogeologic sensitivity. Only 36 of the samples (17.5 percent) were in low or very low sensitivity areas.

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